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GRADE 9

KEVIN SMITH

SUITABLE FOR IEB AND NATIONAL CURRICULUM STUDENTS

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KEVIN SMITH

BSc Eng (Electrical) WITS

Includes exercises with worked through solutions

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ABOUT THE AUTHOR

KEVIN SMITH

Kevin Smith is a young Electrical Engineer who is passionate about Education, specifically Maths and Science. He has been giving extra lessons in Maths and Science for the past 8 years and is the founder of **The Lab Maths and Science Academy** which is attended by students across Johannesburg.

As an extra lesson teacher, Kevin has established the critical areas where students struggle and has written the **Maths Handbook and Study Guides** with these areas in mind.
The books are written in a clear, simple, visual and logical manner. The colour coding facilitates explanations, definitions, formulas, recaps of previous work, hints and ideas.
They are easy to read, easy to understand and easy to apply what has been learnt. They work in conjunction with all other Maths Books. They are welcome additions to the **Handbook and Study Guide** series**.**

Kevin's objective is for the **Maths Handbook and Study Guides** to demystify Maths and help students to reach their potential in this challenging subject. The subtitles of the books are 'Maths made Easy' and this is what he aims to do. Kevin ensures that his work is up to date at all times and that it is suitable for IEB and National Curriculum students.

Beryl Lutrin – Berlut Books
Author of the **Afrikaans Handbook and Study Guide**
Co-author of the **English Handbook and Study Guide**
December 2011

Acknowledgments

I would like to extend my thanks and appreciation to Beryl Lutrin for her invaluable advice which has helped to make this book what it is today.

I would like to thank my family for their continual support and encouragement. My mother Vera Smith deserves a special mention for her assistance in the graphic design of this textbook. I could not have done it without her.

Lastly, I would like to dedicate this book to all of my past and present students, wishing them the best of luck in Mathematics and in life.

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TIPS ON HOW TO STUDY WITH THIS BOOK

1. **Read slowly**. A maths book does not flow like a novel - even missing a single word could cause a misunderstanding in a fundamental concept.

2. Take note of the **colours** used. If something is in colour it is there for a reason.

3. The **environment** in which you study is extremely important. **A quiet room with no distractions** is conducive to learning. You will get very little out of a maths book if you cannot concentrate.

4. **Ensure that each sentence or line** of an equation **is understood** before proceeding.

5. **Do not leave out anything**. Each example illustrates a specific concept and these are rarely repeated. There is very little chance of understanding missed information by reading further in the textbook.

6. All **symbols** in mathematics have a very specific meaning. If there is any uncertainty about the meaning of a term or symbol, do not set it aside, look it up or ask a teacher to explain it to you. The **glossary** in the back of this book will explain most of the important terms.

7. Always study with a **pencil and paper**. Work out proofs and derivations yourself, using the textbook as a guide. **After reading an example, cover it up and attempt the problem yourself, taking note of any errors you made.**

8. Mathematics is a hands-on subject. Sportsman don't become professionals by watching on the side-lines. They **practise** for hours every day. In the same way, you cannot become a mathematician by watching others do maths. **Practice**, **practice** and more **practice** is the only way to truly master maths.

9. Your brain also needs to **rest**. Do not study for hours at a time without a break. Effective studying requires concentration. If you are tired take a **nap**.

10. When **preparing** for an exam or test, make sure that you do as many **past papers** as you can. If you are unsure of how to answer a question, try to find the method in this book before looking at the answer at the back. This will prove very satisfying and build your confidence. Before your exam, practise at least two papers under exam conditions and according to the allocated time.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to …
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

ⓘ **CAPS AI** is the first reliable and trusted academic AI that you can ask questions as you go through your **textbooks, question papers, and notes,** it is programmed with the fundamental **CAPS** curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the **South African CAPS curriculum** and it can further your understanding about any subject topic in general.

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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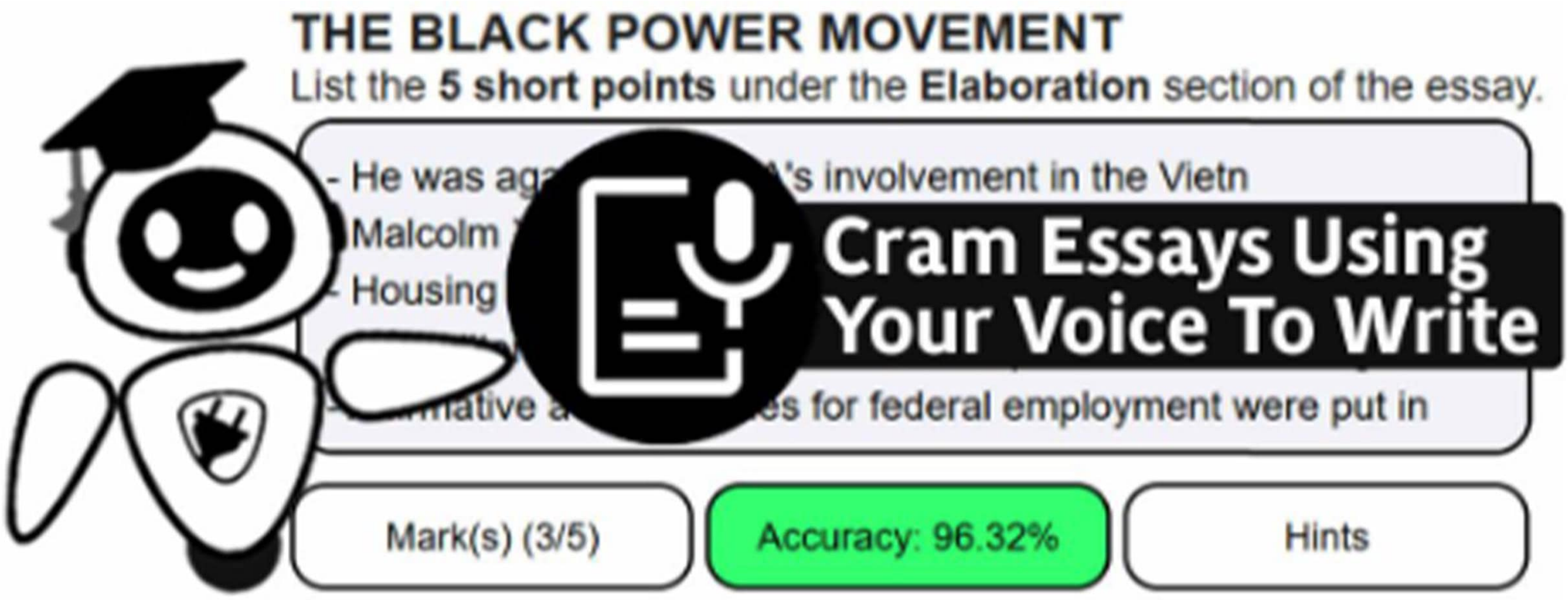

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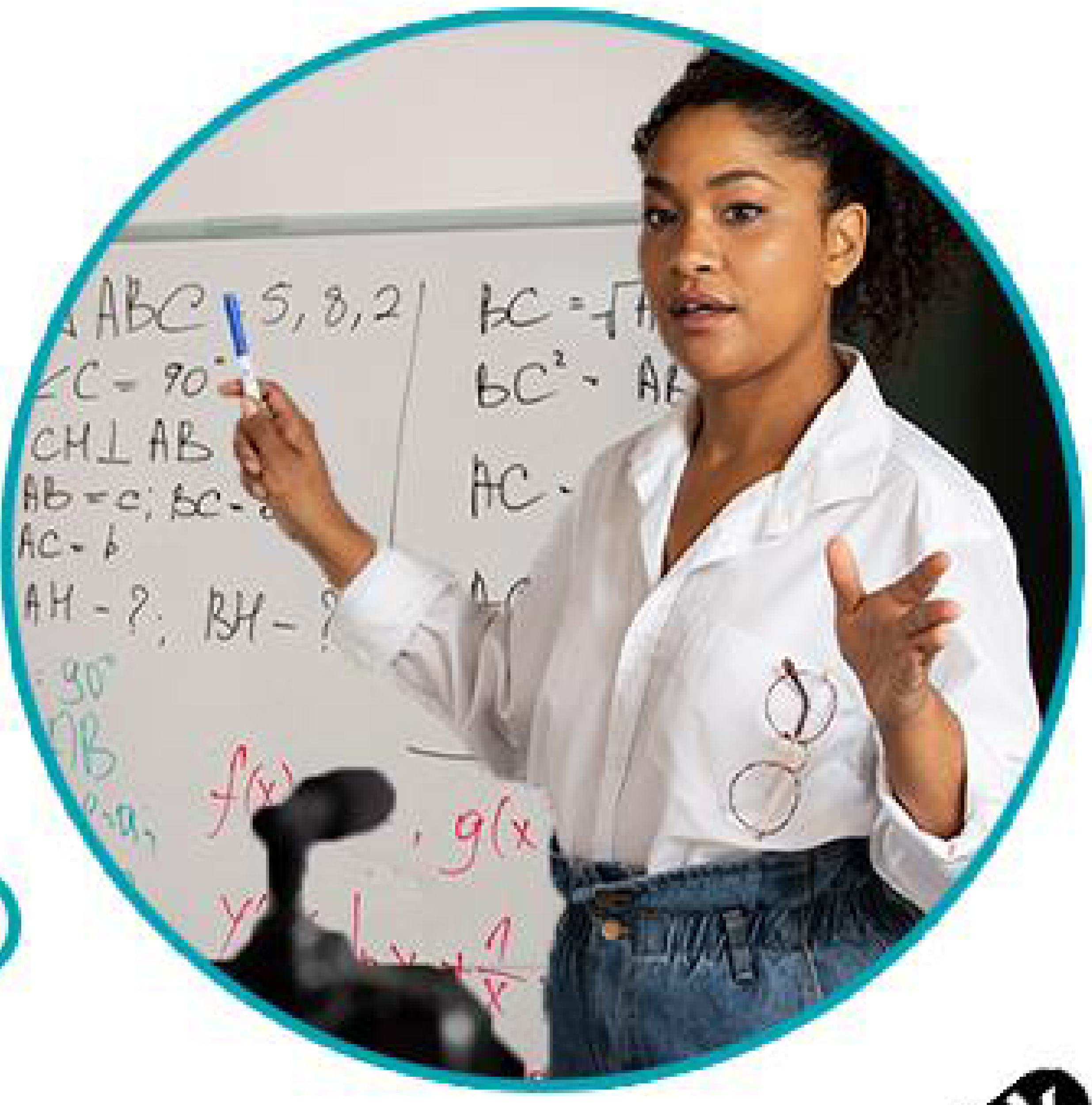

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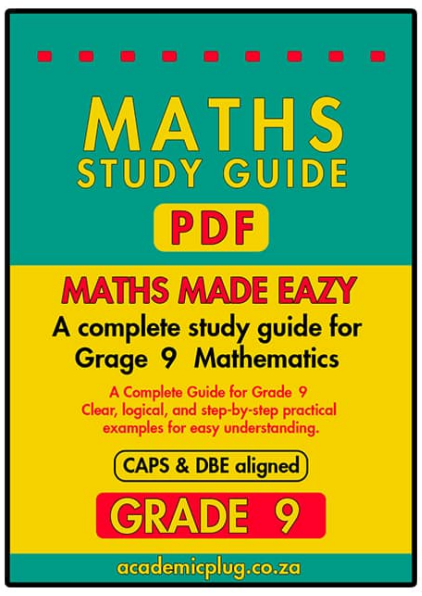

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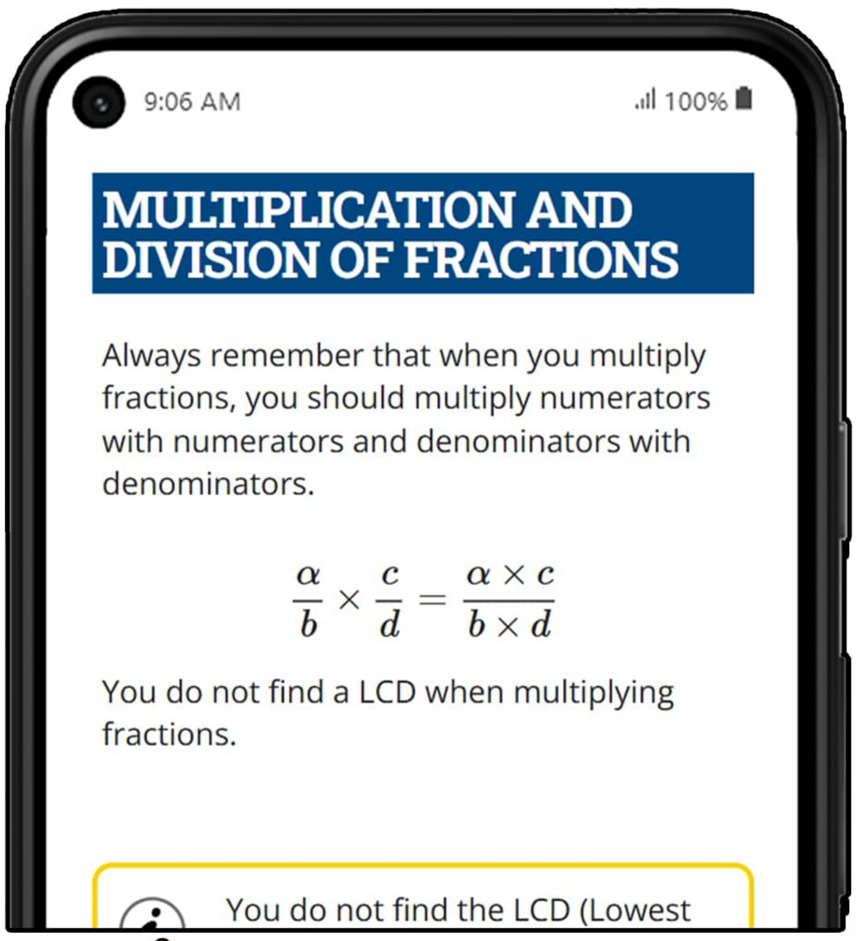

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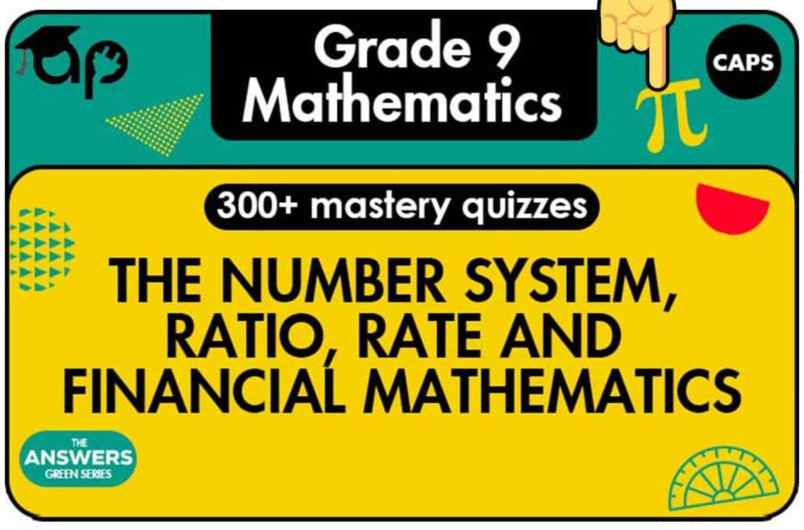

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AI CAPS

CHAPTER 1
THE NUMBER SYSTEM, RATE, PROPORTION AND FINANCIAL MATHEMATICS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
3	**A. The Number System**	1.1	• Describe the real number system by recognising, defining and distinguishing properties of natural numbers, whole numbers, integers, rational numbers, irrational numbers • Perform calculations using all four operations on whole numbers, estimating and using calculators where appropriate • Use prime factorisation of numbers to find LCM and HCF • Solve problems in contexts involving ratio, rate, direct and indirect proportion • Solve problems that involve whole numbers, percentages and decimal fractions in financial contexts
3	• Natural Numbers		
3	• Whole Numbers		
3	• Integers		
3	• Rational Numbers		
3	• Irrational Numbers		
5	**B. Grade 8 Revision**		
5	• Highest Common Factor (HCF) and Lowest Common Multiple (LCM)		
6	• Dividing Quantities in a Given Ratio		
7	• Increasing and Decreasing a Number in a Given Ratio		
8	• Rate		
11	**C. Direct and Indirect Proportion**		
11	• Direct Proportion		
13	• Indirect Proportion		
14	**D. Financial Maths**		
14	• Simple Interest		
15	• Hire Purchase Agreements		
17	• Compound Interest		
19	• Mixed Examples		

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A. THE NUMBER SYSTEM

The real number system consists of many different classifications.
This section recaps on the types of numbers that you have learnt so far and introduces the concepts of **rational** and **irrational numbers.**

NATURAL NUMBERS

{1; 2; 3; 4; 5; 6; 7; ...}
Natural numbers start at 1 and increase in ones up to infinity (∞).
The symbol for a set of natural numbers is: ℕ

WHOLE NUMBERS

{0; 1; 2; 3; 4; 5; 6; 7; ...}
Whole numbers start at 0 and increase in ones up to infinity (∞).
The symbol for a set of whole numbers is: $\mathbb{N}_0$

INTEGERS

{...; –4; –3; –2; –1; 0; 1; 2; 3; 4; ...}
Integers extend whole numbers to include negative numbers.
Integers start at –∞ and increase in ones up to +∞.
The symbol for a set of integers is: ℤ

When we say that numbers increase in ones up to infinity, it means that the process or pattern of adding 1 will continue forever.
The symbol for infinity is ∞.
Natural numbers, whole numbers and integers don't have fractions or decimals.

RATIONAL NUMBERS

Examples of rational numbers are: $\frac{3}{4}$; $0,\dot{3}$; $0,75$

Rational numbers are numbers which can be written as a **fraction** (where the numerator and denominator are integers) or as a **recurring decimal** or as a **decimal that terminates**. For a fraction to be a rational number, the numerator and denominator have to be integers and the denominator cannot be equal to zero.
The symbol for a set of rational numbers is: ℚ

IRRATIONAL NUMBERS

Examples of irrational numbers are: π ; $\sqrt{2}$; $\sqrt[3]{9}$; 2,35408…

Irrational numbers **cannot be written as a fraction** or with **terminating or recurring decimals**. In other words irrational numbers are non-recurring and non-terminating. Examples of **irrational numbers** are **pi (π)** and the **square root of numbers that are not perfect squares or cube roots of numbers that are not perfect cubes.**

The symbol for a set of irrational numbers is: ℚ'

An approximation for π is the rational number $\frac{22}{7}$. However, this is only an approximation. It is important to note that π is still irrational.

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Example: **Complete the following table by placing a tick in the correct column.**

	$\mathbb{N}$	$\mathbb{N}_0$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{Q}'$
$\frac{2}{3}$					
$1{,}25$					
$\sqrt{16}$					
$0{,}2\dot{5}$					
-5					
π					
$\sqrt{18}$					
0					
$0{,}548\ldots$					
$\frac{25}{5}$					

Here are the answers. How did you do?

	$\mathbb{N}$	$\mathbb{N}_0$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{Q}'$
$\frac{2}{3}$				✓	
$1{,}25$				✓	
$\sqrt{16} \rightarrow \sqrt{16} = 4$	✓	✓	✓	✓	
$0{,}2\dot{5}$				✓	
-5			✓	✓	
π					✓
$\sqrt{18}$					✓
0		✓	✓	✓	
$0{,}548\ldots$					✓
$\frac{25}{5} \rightarrow \frac{25}{5} = 5$	✓	✓	✓	✓	

Note the following points:

- **If a number is rational, it cannot be irrational.**
- **If a number is irrational, it cannot be rational.**
- **A natural number is also a whole number, integer and rational number.**
- **A whole number is also an integer and natural rational number.**
- **An integer is also a rational number.**

The above points do not work in reverse. In other words, if a number is an integer, it does not have to be a whole or natural number.

Complete Exercise 1 on page 250.

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B. GRADE 8 REVISION

HIGHEST COMMON FACTOR (HCF) AND LOWEST COMMON MULTIPLE (LCM)

The highest common factor is the largest factor which is common to two or more numbers.

The lowest common multiple is the lowest multiple which is common to two or more numbers.

<u>Example</u>: Given the numbers 48 and 180:

a) Use the ladder method to write 48 and 180 as a product of their prime factors.
b) Determine the highest common factor of 48 and 180.
c) Determine the lowest common multiple of 48 and 180.

a)

2	48	→	divide 48 by its smallest prime factor (2)
2	24	→	divide the answer (24) by its smallest prime factor (2)
2	12	→	divide the answer (12) by its smallest prime factor (2)
2	6	→	divide the answer (6) by its smallest prime factor (2)
3	3	→	divide the answer (3) by its smallest prime factor (3)
	1	→	Stop when the answer is equal to 1

2	180	→	divide 180 by its smallest prime factor (2)
2	90	→	divide the answer (90) by its smallest prime factor (2)
3	45	→	divide the answer (45) by its smallest prime factor (3)
3	15	→	divide the answer (15) by its smallest prime factor (3)
5	5	→	divide the answer (5) by its smallest prime factor (5)
	1	→	Stop when the answer is equal to 1

$\therefore 48 = 2\times2\times2\times2\times3$ and $180 = 2\times2\times3\times3\times5$

$= 2^4 \times 3^1$ $\qquad$ $= 2^2 \times 3^2 \times 5^1$

b) The HCF will always be the product of the **bases** which are **common** to both numbers with the **lowest exponent**. So, in the above example, the **bases** which are **common** to both numbers are **2** and **3**. For the base of **2**, the lowest exponent is **2** and for the base of **3**, the lowest exponent is **1**.

$$\therefore \text{HCF} = 2^2 \times 3^1$$
$$= 4\times3$$
$$= 12$$

c) The LCM is the product of **each base** with the **highest exponent**. In the above example the bases are **2**, **3** and **5**. The highest exponent of **2** is **4**, the highest exponent of **3** is **2** and the highest exponent of **5** is **1**.

$$\therefore \text{LCM} = 2^4 \times 3^2 \times 5^1 = 720$$

When finding the LCM, bases do not have to be common.
When finding the HCF, bases do have to be common.
Common bases between numbers are not repeated when calculating the HCF and LCM.

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DIVIDING QUANTITIES IN A GIVEN RATIO

It is often required to divide numbers into a given ratio.
A ratio divides a number into different parts. For example, **a ratio of 2:3 means** there are **a total of 5** parts and **a ratio of 3:4 means** there is **a total of 7 parts**.
This concept will also be in the examples which follow.

STEPS TO DIVIDING A NUMBER INTO A GIVEN RATIO:

1) **Add up each number in the ratio to determine the total number of parts.**
2) **Calculate 1 part by dividing the number by the total number of parts.**
3) **Multiply 1 part into the given ratio.**

Example 1: Divide 100 into a ratio of 3:2.

Step 1: Determine the total number of parts:
$\text{Total parts} = 3 + 2 = 5$

Step 2: Calculate 1 part.
$$1 \text{ part} = \frac{100}{5} = 20$$

Step 3: Multiply 1 part into the given ratio.
$3 \text{ parts} = 20 \times 3 = 60$ and $2 \text{ parts} = 20 \times 2 = 40$

$\therefore$ 100 divided into a ratio of 3:2 is 60 parts to 40 parts.

Example 2: Daniel, Thabang and Ridwaan start a business together. Daniel contributes R6 000, Thabang contributes R12 000 and Ridwaan contributes R15 000 to start the business.

a) **Write down the ratio of the contributions of each person in its simplest form.**
b) **In the first year the business makes a profit of R88 000. The profit is split in the same ratio as their initial contributions. How much does each person receive?**

a) $15\,000 : 12\,000 : 6\,000 \rightarrow \text{HCF} = 3\,000$
$$= \frac{15\,000}{3\,000} : \frac{12\,000}{3\,000} : \frac{6\,000}{3\,000}$$
$$= 5 : 4 : 2$$

b) **Step 1:** Determine the total number of parts.
$5 : 4 : 2$
$\text{Total parts} = 5 + 4 + 2 = 11$

Step 2: Calculate 1 part.
$$1 \text{ part} = \frac{R88\,000}{11} = R8\,000$$

Step 3: Multiply 1 part into the ratio.
The ratio is 5:4:2 → Ridwaan : Thabang : Daniel

$\therefore$ Ridwaan gets: $5 \times 8\,000 = R40\,000$
Thabang gets: $4 \times 8\,000 = R32\,000$
Daniel gets: $2 \times 8\,000 = R16\,000$

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INCREASING AND DECREASING A NUMBER IN A GIVEN RATIO

You are required to be able to increase or decrease a quantity in a given ratio.
If you are increasing a quantity in a ratio of $x : y$ the new quantity will be:

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x} \quad \text{where } y \text{ is greater than } x.$$

If you are decreasing a quantity in a ratio of $x : y$ the new quantity will be:

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x} \quad \text{where } y \text{ is less than } x.$$

<u>Example 1</u>: Increase 58 in a ratio of 4:5.

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x}$$

$$= 58 \times \frac{5}{4} \rightarrow \text{when you are increasing, the larger number goes on top}$$

$$= \frac{290}{4}$$

$$= 72{,}5$$

<u>Example 2</u>: Decrease 58 in a ratio of 4:5.

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x}$$

$$= 58 \times \frac{4}{5} \rightarrow \text{when you are decreasing, the smaller number goes on top}$$

$$= \frac{232}{5}$$

$$= 46{,}4$$

<u>Example 3</u>: If the current price of petrol is R11,90 per litre and it is increased in a ratio of 3:2, what will the new price of petrol be?

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x}$$

$$= 11{,}90 \times \frac{3}{2} \rightarrow \text{when you are increasing, the larger number goes on top}$$

$$= \text{R}17{,}85 \text{ per litre}$$

<u>Example 4</u>: If the current price of oil is R24 per litre and it decreases in a ratio of 3:4, what will the new price of oil be?

$$\text{new quantity} = \text{original quantity} \times \frac{y}{x}$$

$$= 24 \times \frac{3}{4} \rightarrow \text{when you are decreasing, the smaller number goes on top}$$

$$= \text{R}18 \text{ per litre}$$

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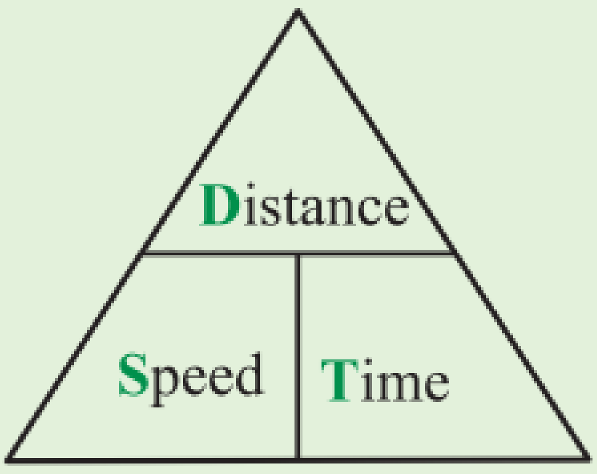
RATE

You were introduced to the concept of rate in Grade 8. This concept will now be expanded upon.

A rate is used in order to **compare quantities with different units**. For example, speed is often measured in **kilometres per hour**. In this case you are **comparing** a **distance** (kilometres) with **time** (hours). The formulas below are useful when dealing with rate problems involving speed distance and time.



$\text{Distance} = \text{Speed} \times \text{Time}$ $\quad\quad$ $\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$ $\quad\quad$ $\text{Time} = \dfrac{\text{Distance}}{\text{Speed}}$

<u>Example 1</u>: A car travelling at a constant speed covers a distance of 60km in 36 minutes.
a) At what speed is the car travelling? Give your answer in km/h.
b) How far would the car travel in 1 hour and 12 minutes?

a) Before you calculate the speed that the car is travelling at, you have to convert the time into hours:

$$36\,\text{minutes} = \frac{36}{60}\ \text{hours} \rightarrow \text{divide by 60 to convert minutes to hours}$$
$$= 0,6\,\text{hours}$$

You can now calculate the car's speed:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$
$$= \frac{60}{0,6}$$
$$= 100\,\text{km/h}$$

b) Before you calculate the distance which the car has travelled, you have to convert the minutes' portion of the time into hours:

$$12\,\text{minutes} = \frac{12}{60}\ \text{hours} \rightarrow \text{divide by 60 to convert minutes to hours}$$
$$= 0,2\,\text{hours}$$

$$\therefore \text{Total time} = 1,2\ \text{hours} \rightarrow 1 + 0,2$$
$$\text{distance} = \text{speed} \times \text{time}$$
$$= 100 \times 1,2 \rightarrow \text{you calculated the speed of the car in the previous question}$$
$$= 120\,\text{km}$$

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Example 2: **A car travels at an average speed of 100km/h for 3 hours and 36 minutes. What constant speed must the car travel at to cover the same distance in 2 hours and 24 minutes?**

The first step in solving this problem is to calculate the distance which the car travelled in 3 hours and 36 minutes. To calculate the distance that the car has travelled, you must convert the minutes' portion of the time into hours:

$$36\text{ minutes} = \frac{36}{60}\text{ hours} \rightarrow \text{divide by 60 to convert minutes to hours}$$
$$= 0,6\text{ hours}$$
$$\therefore \text{Total time} = 3,6\text{ hours} \rightarrow 3 + 0,6$$
$$\text{distance} = \text{speed} \times \text{time}$$
$$= 100 \times 3,6$$
$$= 360\text{ km}$$

Before calculating the speed at which the car has to travel, you have to convert the time to hours:

$$24\text{ minutes} = \frac{24}{60}\text{ hours} \rightarrow \text{divide by 60 to convert minutes to hours}$$
$$= 0,4\text{ hours}$$
$$\therefore \text{Total time} = 2,4\text{ hours} \rightarrow 2 + 0,4$$

Now you can calculate the speed:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$
$$= \frac{360}{2,4}$$
$$= 150\text{ km/h}$$

Example 3: **A builder works for 7 hours a day, 5 days a week. At the end of each week he gets paid R6 000.**

a) What is the builder's daily rate?
b) What is the builder's hourly rate?

a) $$\text{daily rate} = \frac{\text{total charge}}{\text{number of days}}$$
$$= \frac{6\,000}{5}$$
$$= \text{R}1200\text{ per day}$$

b) Before calculating the builder's hourly rate, you need to work out how many hours the builder works in a week:

$$\text{Total hours} = 7 \times 5$$
$$= 35\text{ hours each week}$$

$$\text{hourly rate} = \frac{\text{total charge}}{\text{number of hours}}$$
$$= \frac{6\,000}{35}$$
$$= \text{R}171,43\text{ per hour}$$

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<u>Example 4</u>: **A water tank has a hole in it which leaks water at a rate of 225 millilitres (*ml*) per minute.**

a) How many litres of water leak in 1 hour?
b) If the tank is empty after 5 hours and 45 minutes, how many litres of water can the tank hold? Give your answer correct to 1 decimal place.

There are 1 000 *ml* in 1 litre. To convert millilitres to litres, divide by 1 000.

As the question asks for answers in litres, convert the rate from *ml* per minute to litres per minute.

$225\,ml = 0,225$ litres → divide by 1000 to convert from ml to litres

$\therefore$ 0,225 litres leak out the tank in 1 minute

a) Number of litres = rate × time

$= 0,225 \times 60$ → there are 60 minutes in 1 hour and $1000ml$ in a litre

$= 13,5$ litres

b) Method 1: Covert the minutes' portion to hours and use the hourly rate.

$40\text{ minutes} = \frac{45}{60}$ hours → divide by 60 to convert minutes to hours

$= 0,75$ hours

$\therefore$ Total time $= 5,75$ hours → $5 + 0,75$

Number of litres = rate × time

$= 13,5 \times 5,75$ → the tanker loses 13,5 litres per hour

$=77,6$ litres

$\therefore$ The tank can hold 77,6 litres.

Method 2: Covert the time to minutes and use the rate per minute.

5 hours $= 5 \times 60$ minutes → multiply by 60 to convert hour to minutes

$= 300$ minutes

$\therefore$ Total time $= 345$ minutes → $300 + 45$

Number of litres = rate × time

$= 0,225 \times 345$ → the tanker loses 0,225 litres per minute

$=77,6$ litres

$\therefore$ The tank can hold 77,6 litres.

Complete Exercise 2 on page 250.

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C. DIRECT AND INDIRECT PROPORTION

DIRECT PROPORTION

Two quantities are **directly proportional** if **as one quantity increases, the other increases**. Or, as **one quantity decreases, the other decreases**.

If two quantities are **directly proportional** the **ratio between the quantities remains constant**.

Example 1: A school orders 52 calculators at a cost of R18 200.
a) How much would 9 calculators cost?
b) How many calculators can be purchased for R8 750?

a) Let the cost of 9 calculators be x.

Cost	Number of calculators
x	9
18 200	52

As the **ratio remains constant**, you can now set up an equation to solve for x:

$$\frac{x}{18200} = \frac{9}{52} \rightarrow \text{multiply both sides by } 18200$$

$$\therefore x = \frac{9}{52} \times 18200$$

$$= \text{R}3150$$

Always put whatever you are looking for (x) on top (as the numerator).

b) Let x be the number of calculators which can be purchased:

Number of calculators	Cost
x	8 750
52	18 200

As the **ratio remains constant**, you can now set up an equation to solve for x:

$$\frac{x}{52} = \frac{8750}{18200} \rightarrow \text{multiply both sides by } 52$$

$$\therefore x = \frac{8750}{18200} \times 52$$

$$= 25 \text{ calculators}$$

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Example 2: **12 boxes of tiles can tile an area of 30 m^2.**
a) How many boxes are required to tile an area of 55 m^2?
b) What area can be tiled with 27 boxes of tiles?

a) Let the number of boxes required be x.

Boxes	Area
x	55
12	30

As the **ratio remains constant**, you can now set up an equation to solve for x:

$$\frac{x}{12} = \frac{55}{30} \rightarrow \text{multiply both sides by 12}$$

$$\therefore x = \frac{55}{30} \times 12$$

$$= 22 \text{ boxes}$$

b) Let the area that can be tiled be x:

Area	Boxes
x	27
30	12

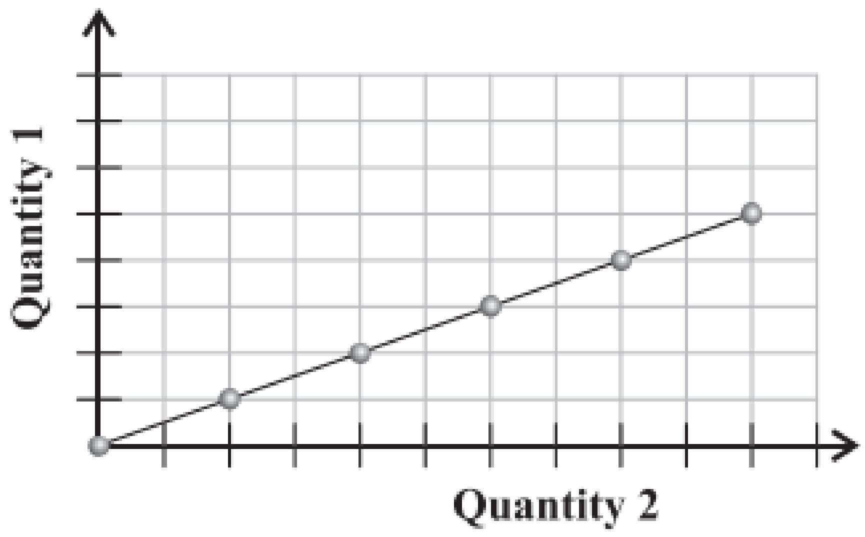
As the **ratio remains constant**, you can now set up an equation to solve for x:

$$\frac{x}{30} = \frac{27}{12} \rightarrow \text{multiply both sides by 30}$$

$$\therefore x = \frac{27}{12} \times 30$$

$$= 67{,}5 \text{ m}^2 \rightarrow \text{area is measured in m}^2$$

A graph of two quantities which are directly proportional is a straight-line graph, which passes through the origin. It shows that as one quantity increases, the other increases in the same ratio, or as one quantity decreases, the other decreases in the same ratio.



Complete Exercise 3 on page 251.

INDIRECT PROPORTION (INVERSE PROPORTION)

Two quantities are **inversely proportional** if, **as one quantity increases, the other decreases**. Or, as **one quantity decreases, the other increases**.

If two quantities are **inversely proportional** the **product of the two quantities remains constant**.

Example 1: It takes 12 painters 8 days to paint a house. How long would it take for 3 painters to paint the same house?

Let the number of days it would take 3 painters be x:

Number of Painters	Number of Days
3	x
12	8

As the **product of the quantities remains constant**, you can now set up an equation to solve for x:

$3 \times x = 12 \times 8$

$\therefore 3x = 96 \rightarrow$ divide both sides by 3

$\therefore x = 32$ days

Example 2: A life boat designed for 10 people is stocked with enough water to last for 30 days. If 4 people are in the boat, how many days would the water last?

Let the number of days the water would last be x:

Number of People	Number of Days
4	x
10	30

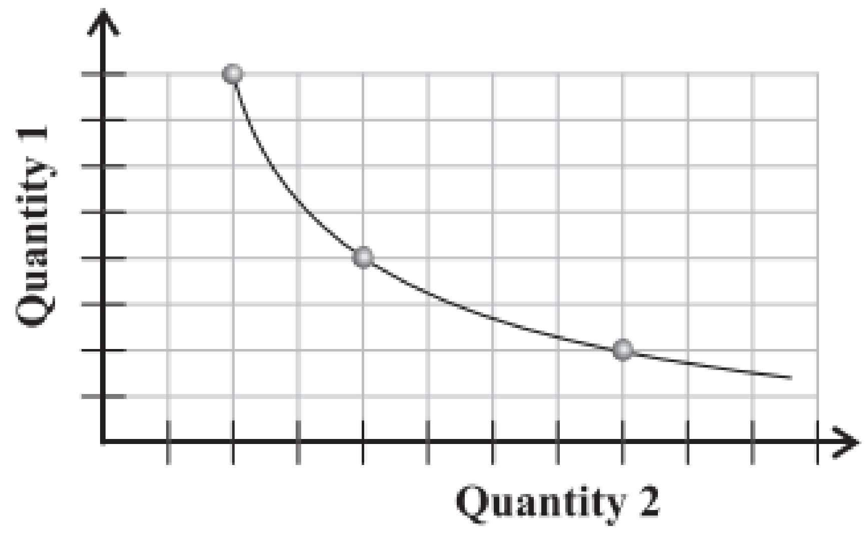
As the **product of the quantities remains constant**, you can now set up an equation to solve for x:

$4 \times x = 10 \times 30$

$\therefore 4x = 300 \rightarrow$ divide both sides by 4

$\therefore x = 75$ days

A graph of two quantities which are inversely proportional is a curved graph called a hyperbola. It shows the relationship that as one quantity increases the other decreases.



Complete Exercise 4 on page 251.

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D. FINANCIAL MATHS

In grade 8 you dealt with **simple interest** calculations. These will be revised and expanded upon and you will also be introduced to the concept of **compound interest**.

SIMPLE INTEREST

Simple interest is interest which is calculated on the **original investment or loan**. The **original amount invested or loaned** is called the **principal** amount.
The formula in the green block below is used to **calculate the final amount of an investment or loan once simple interest has been added.**

Simple Interest Formula

$$A = P(1+in)$$

Where: $A \rightarrow$ **The final value of the investment or loan**
$P \rightarrow$ **The original investment or loan amount (principle amount)**
$n \rightarrow$ **The time period of the investment or loan (usually in years)**
$i \rightarrow$ **The simple interest rate charged on the investment or loan**

When performing calculations, interest rates are given as a percentage. The interest rate must be divided by 100 when using it in the formula.

Example 1: **R11 500 is invested into a bank account at a simple interest rate of 9,5% per annum. The money is invested for a period of 5 years.**

a) What will the value of the investment be at the end of 5 years?
b) What was the interest earned on the investment?

a)
$$\begin{aligned} A &= P(1+in) \\ &= 11500[1+(0,095)(5)] \\ &= R16962,50 \end{aligned}$$

b)
$$\begin{aligned} \text{Interest} &= \text{Final amount} - \text{initial investment} \\ &= 16962,50 - 11500 \\ &= R5462,50 \end{aligned}$$

Per annum means yearly and is often abbreviated as p.a. in questions.

Example 2: **A loan of R2 500 is taken out at a simple interest rate of 7% p.a.**

a) If the loan is for a period of 4 years. How much money must be repaid at the end of 4 years?
b) What is the interest paid on the loan?

a)
$$\begin{aligned} A &= P(1+in) \\ &= 2500[1+(0,07)(4)] \\ &= R3200 \end{aligned}$$

b)
$$\begin{aligned} \text{Interest} &= \text{total loan} - \text{initial loan amount} \\ &= 3200 - 2500 \\ &= R700 \end{aligned}$$

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Example 3: **A loan of R8 800 is taken out at a simple interest rate of 9,5% p.a.**

a) If the loan is for a period of 20 years, how much money must be repaid at the end of 20 years?

b) What is the interest paid on the loan?

a) $A = P(1+in)$

$= 8800[1+(0,095)(20)]$

$= R25\,520$

b) $\text{Interest} = \text{total loan} - \text{initial loan amount}$

$= 25\,520 - 8800$

$= R16\,720$

HIRE PURCHASE AGREEMENTS

Hire purchase agreements are loans taken out to buy an article or goods. Hire purchase agreements usually work in the following way:

- A cash deposit is paid
- **Simple interest** is charged on the **remaining balance**.
- The loan is then **paid back by equal** (usually) monthly **payments**.

Example 1: **Thabo purchases a bedroom suite for R25 000. In order to pay for it, he takes out a hire purchase loan. The interest on the loan is 14% p.a. for a period of 3 years and he pays a cash deposit of R5000.**

a) What is the amount of the loan?

b) How much will Thabo pay over the 3 years excluding the cash deposit?

c) If Thabo repays the loan by equal monthly payments, how much will he pay each month?

d) How much did Thabo pay for bedroom suite in total?

a) $\text{Loan amount} = 25\,000 - 5\,000 \rightarrow \text{total cost} - \text{cash deposit}$

$= R20\,000$

b) $A = P(1+in)$

$= 20\,000[1+(0,14)(3)]$

$= R28\,400$

c) In 3 years, there are 36 months $\rightarrow 3 \times 12 = 36$ months

$\text{Monthly payments} = \frac{28\,400}{36} \rightarrow \frac{\text{total loan amount}}{\text{total months}}$

$= R788{,}89$ per month

d) $\text{Total payment} = \text{cash deposit} + \text{final loan amount}$

$= 5\,000 + 28\,400$

$= R33\,400$

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<u>Example 2</u>: Maya purchases a television for R17 000. She uses a hire purchase loan with an interest rate of 11,5% p.a. for a period of 2 years. The loan requires that a 12% cash deposit is paid.

a) How much is the cash deposit?
b) How much will Maya pay over the 2 years excluding the cash deposit?
c) If Maya repays the loan by equal monthly payments, how much will she pay each month?
d) In total, how much did Maya pay for her television?

a) $\text{Deposit} = 17\,000 \times 0{,}12 \rightarrow 12\% = \frac{12}{100}$

$= \text{R}2\,040$

b) $\text{Loan amount} = 17\,000 - 2\,040 \rightarrow \text{total cost} - \text{cash deposit}$

$= \text{R}14\,960$

$A = P(1 + in)$

$= 14\,960[1 + (0{,}115)(2)]$

$= \text{R}18\,400{,}80$

c) In 2 years, there are 24 months $\rightarrow 2 \times 12 = 24$ months

$\text{Monthly payments} = \frac{18\,400{,}80}{24} \rightarrow \frac{\text{total loan amount}}{\text{total months}}$

$= \text{R}766{,}70$ per month

d) $\text{Total payment} = \text{cash deposit} + \text{final loan amount}$

$= 2\,040 + 18\,400{,}80$

$= \text{R}20\,440{,}80$

Complete Exercise 5 on pages 251 and 252.

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COMPOUND INTEREST

You have previously dealt with **simple interest**. In this case **interest is calculated** on the initial investment or loan.
Compound interest is interest which is **calculated on the amount in the account** at the time of the interest calculation. In this method, **interest is earned on interest**.

Illustrative Example: An amount of R1 000 is invested into an account at an interest rate of 10% p.a. compounded annually. How much will the investment be worth at the end of 3 years.

Year 1:

$$\begin{aligned} A &= P(1+in) \\ &= 1000[1+(0,1)(1)] \\ &= \text{R}1100 \end{aligned}$$

As interest is compounded, in the 2nd year interest will be earned on R1 100 (the amount in the account) not on the original investment as is the case with simple interest.

Year 2:

$$\begin{aligned} A &= P(1+in) \\ &= 1100[1+(0,1)(1)] \\ &= \text{R}1210 \end{aligned}$$

Year 3:

$$\begin{aligned} A &= P(1+in) \\ &= 1210[1+(0,1)(1)] \\ &= \text{R}1331 \end{aligned}$$

As can be seen from the above example, when using **compound interest**, **interest is earned on the amount in the account at the end of each year**. It would be impractical to perform calculations as shown above for investments or loans which span many years. This leads us onto the formula for compound interest which is shown in the green block below:

Compound Interest Formula

$$A = P(1+i)^n$$

Where: $A \rightarrow$ **The final value of the investment or loan**
$P \rightarrow$ **The original investment or loan amount (principle amount)**
$n \rightarrow$ **The time period of the investment or loan (usually in years)**
$i \rightarrow$ **The compound interest rate charged on the investment or loan**

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Example 1: **An amount of R10 000 is invested into an account at an interest rate of 8% p.a. compounded annually. How much will the investment be worth at the end of 5 years.**

$$A = P(1+i)^n$$
$$= 10\,000(1+0{,}08)^5$$
$$= R14\,693{,}28$$

Example 2: **A loan of R25 000 is taken out at an interest rate of 12,5% p.a. compounded annually.**

a) If the loan is paid back in full at the end of 8 years, calculate the amount that will have to be paid back.
b) What was the interest that was paid on the loan?

a) $A = P(1+i)^n$
$$= 25\,000(1+0{,}125)^8$$
$$= R64144{,}61$$

b) Interest = final value − original investment
$$= 64144{,}61 - 25\,000$$
$$= R39144{,}61$$

Example 3: **Joseph and Natasha each invest R2 000 into two different savings accounts for 5 years. Joseph's account offers an interest rate of 10% p.a. simple interest. Natasha's account offers an interest rate of 9% p.a. compounded annually.**

a) How much will each person have in their account at the end of 5 years?
b) Who made the better investment?

a)

Joseph	Natasha
$A = P(1+in)$ $= 2\,000[1+(0{,}1)(5)]$ $= R3\,000$	$A = P(1+i)^n$ $= 2\,000(1+0{,}09)^5$ $= R3\,077{,}25$

b) Natasha, as interest is compounded, the amount of interest she earns increases every year. Even though Joseph's account offered a higher interest rate, the interest he earns is simple and therefore stays the same each year.

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MIXED EXAMPLES

The mixed examples require knowledge of Grade 8 equations. It is recommended that you revise equations on page 93 before attempting them.

Example 1: **Kione invests Rx into a savings account which offers an interest rate of 8% per annum compounded annually. After 5 years, there is R9 550,63 in the account. How much was initially invested?**

$A = P(1+i)^n$

$\therefore 9\,550,63 = P(1+0,08)^5 \rightarrow$ divide both sides by $(1+0,08)^5$

$\therefore \dfrac{9\,550,63}{(1+0,08)^5} = P$

$\therefore P = \text{R}6\,500$

Do not round off any numbers off in financial mathematics until you reach your final answer.

Example 2: **Alexandra invests R1000 into a savings account which offers an interest rate of 9% per annum simple interest. After n years, there is R1 810 in the account. For how many years was the money invested?**

Method 1

$A = P(1+in)$

$\therefore 1810 = 1000(1+0,09n) \rightarrow$ distribute the 1000

$\therefore 1810 = 1000 + 90n \rightarrow$ take the 1000 to the LHS

$\therefore 1810 - 1000 = 90n \rightarrow$ divide both sides by 90

$\therefore \dfrac{810}{90} = n$

$\therefore n = 9$ years

Method 2

$A = P(1+in)$

$\therefore 1810 = 1000(1+0,09n) \rightarrow$ divide both sides by 1000

$\therefore \dfrac{1810}{1000} = 1 + 0,09n \rightarrow$ take the 1 to the LHS

$\therefore 1,81 - 1 = 0,09n \rightarrow$ divide both sides by 0,9

$\therefore \dfrac{0,81}{0,09} = n$

$\therefore n = 9$ years

Complete Exercise 6 on page 252 and
the Mixed Exercise on pages 252 and 253.

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LIFE ORIENTATION

REVISION BOOKLET

TERM 2
2024
GRADE 12

The revision program is designed to assist you in revising the critical content and skills envisaged/planned for term two. The purpose is to prepare you to understand the key concepts and to provide you with an opportunity to establish the required standards and application of the necessary knowledge to succeed in the subject.

Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

AI CAPS

Question 1 : Explained Answers By CAPS AI

ⓘ **CAPS AI** is the first reliable and trusted academic AI that you can ask questions as you go through your **textbooks, question papers, and notes,** it is programmed with the fundamental **CAPS** curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the **South African CAPS curriculum** and it can further your understanding about any subject topic in general.

Learn With CAPS AI

ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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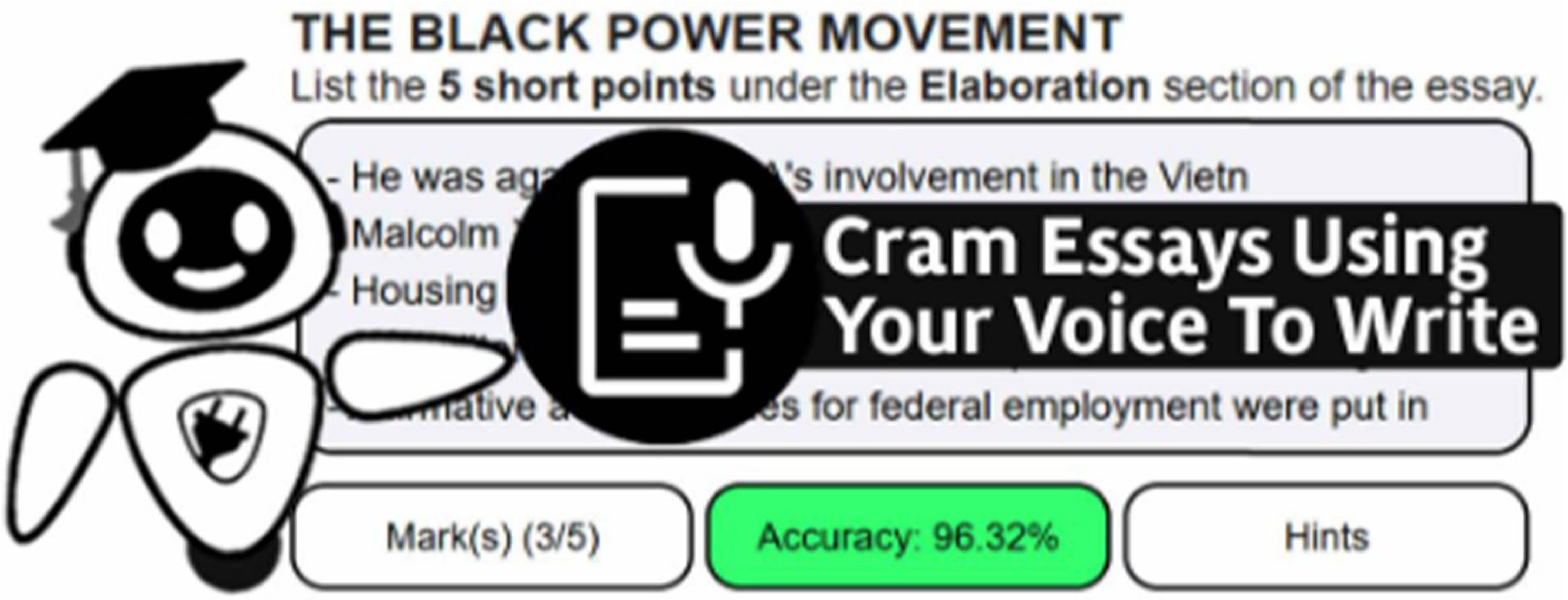

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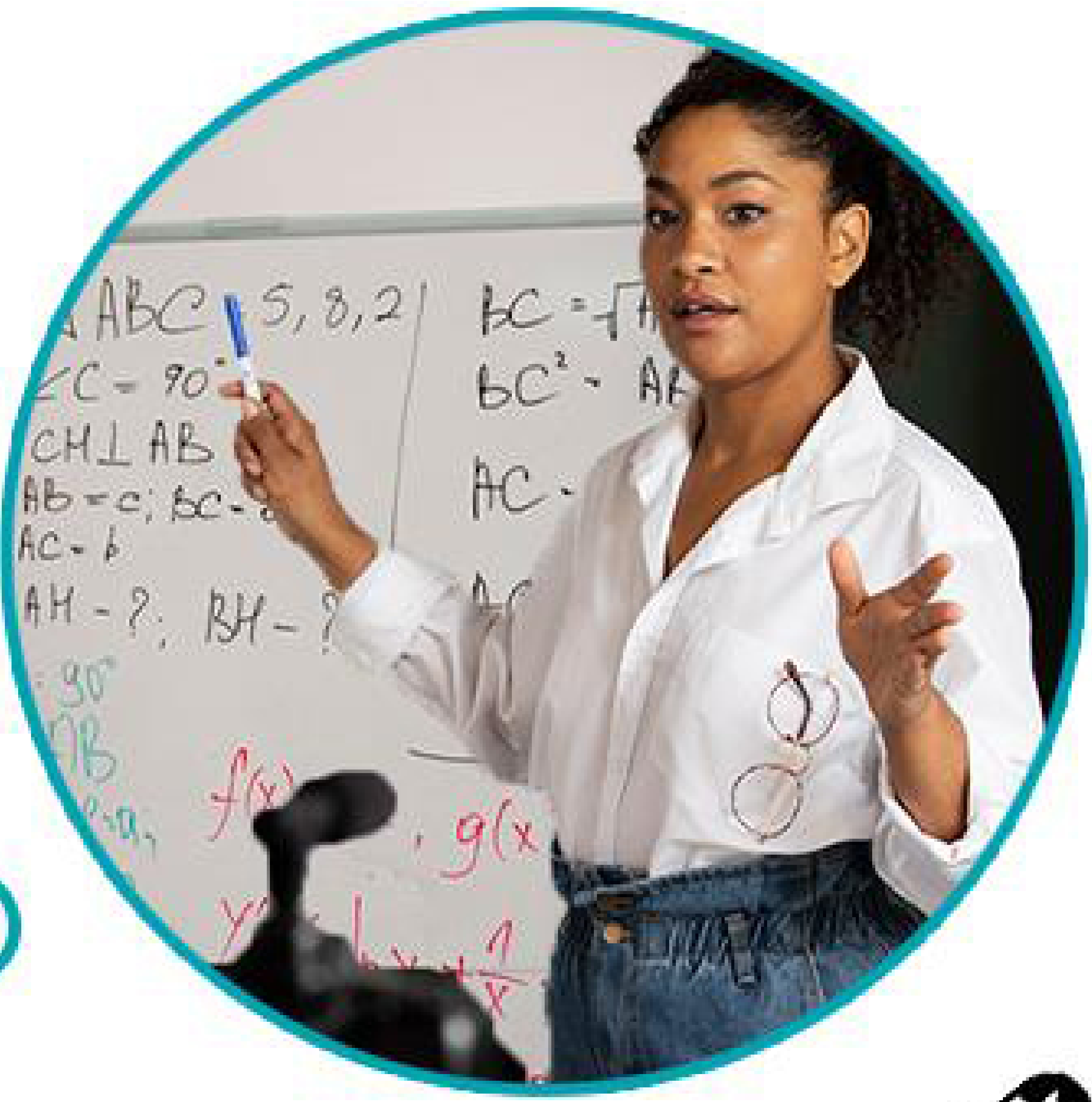

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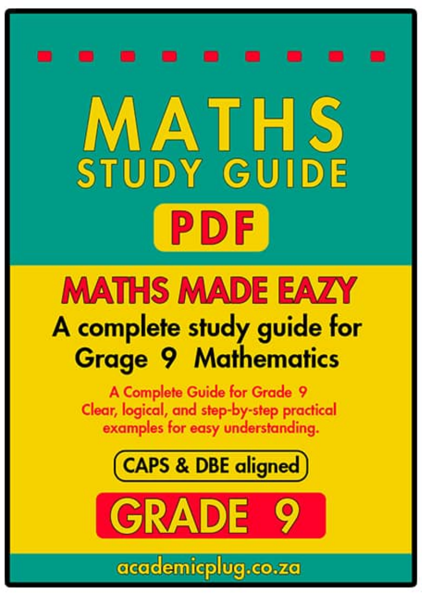

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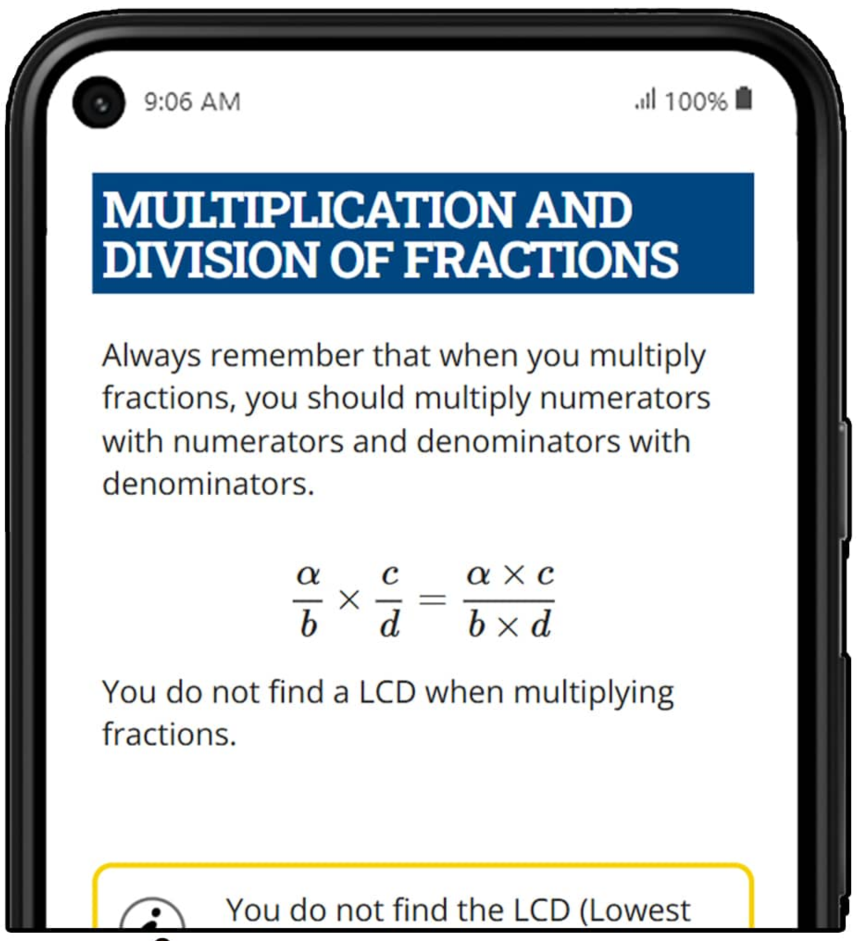

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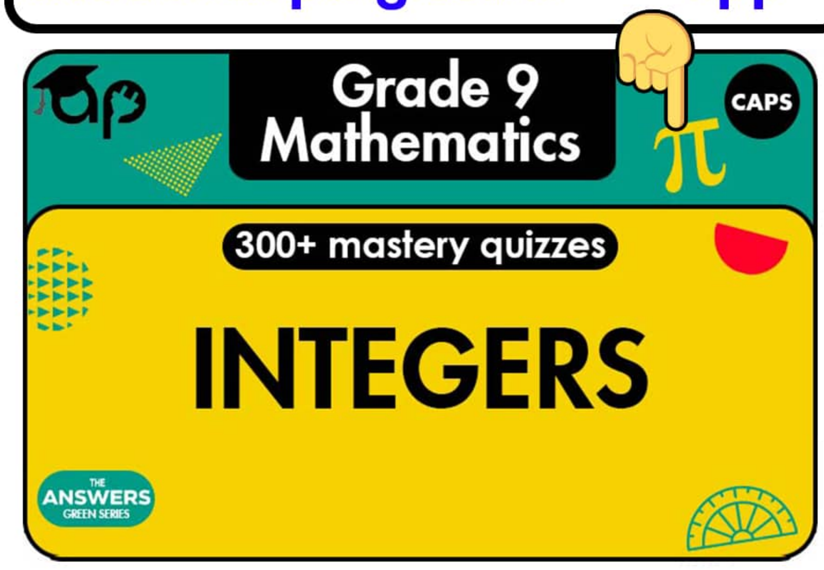

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CHAPTER 2 - INTEGERS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
21	**A. Grade 8 Revision**	1.3	• Perform calculations involving all four operations with integers
21	• Ordering of Integers		• Perform calculations involving all four operations with numbers that involve the squares, cubes, square roots and cube roots of integers
21	• Addition and Subtraction of Integers		• Use the commutative, associative and distributive properties of addition and multiplication for integers as well as the additive and multiplicative inverses for integers in calculations
21	• The Commutative and Associative Properties of Integers		• Solve problems in contexts involving multiple operations with integers
22	• The Additive Inverse		
22	• Rules of Signs for Multiplication of Integers		
22	• Division of Integers		
22	• Squares and Cubes		
23	**B. Revision of Addition and Subtraction of Like Terms**		
23	• Revision of Addition and Subtraction of Like Terms		
24	**C. Multiplication of Integers in Algebra**		
25	**D. Division of Integers in Algebra**		
26	**E. Squares and Cubes of Integers**		

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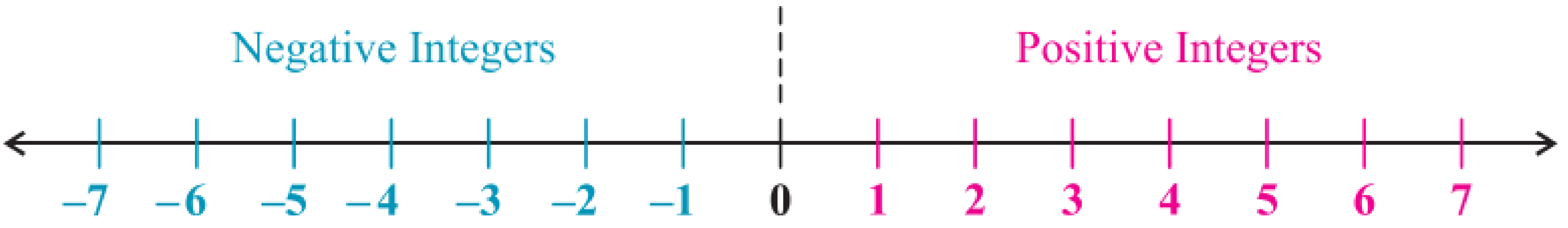
A. GRADE 8 REVISION

Examples of integers are: {…; –4; –3; –2; –1; 0; 1; 2; 3; 4; ...}

Integers extend whole numbers to include negative numbers.
Integers start at $-\infty$ and increase in ones up to $+\infty$.
This means that numbers which contain **fractions** or **decimals** are **not** part of **Integers**.
The symbol for the set of integers is $\mathbb{Z}$.

ORDERING OF INTEGERS

The number line below shows how integers are ordered. As you move to the **right** on the number line, **numbers increase** and as you move to the **left**, **numbers decrease**.



ADDITION AND SUBTRACTION OF INTEGERS

It is important to note that $x - y$ is the same as writing $x + (-y)$.

<u>Example</u>: Calculate the value of:

a) $3+(-1)+(-2)$

b) $-5+6-7$

c) $2+(-3)+(-5)$

d) $-2-1+10$

a) $3+(-1)+(-2)$
$=2-2$
$=0$

b) $-5+6-7$
$=1-7$
$=-6$

c) $2+(-3)+(-5)$
$=-1-5$
$=-6$

d) $-2-1+10$
$=-3+10$
$=7$

THE COMMUTATIVE AND ASSOCIATIVE PROPERTIES OF INTEGERS

The order in which you add integers does not matter.

<u>Example 1</u>: Calculate the value of $-6+12-3+5-4$.

Method 1: Add up each number individually.

$-6+12-3+5-4 \rightarrow -6+12=6$
$=6-3+5-4 \rightarrow 6-3=3$
$=3+5-4 \rightarrow 3+5=8$
$=8-4$
$=4$

Method 2: Add all the positive integers and then the negative integers using the commutative and associative properties of integers.

$-6+12-3+5-4 \rightarrow$ rewrite the sum so that all the positive integers are first
$=12+5-6-3-4 \rightarrow 12+5=17$ and $-6-3-4=-13$
$=17-13$
$=4$

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THE ADDITIVE INVERSE

A number and its additive inverse always add up to 0. For example, the additive inverse of 5 is –5 because $5+(-5)=0$.

RULES OF SIGNS FOR MULTIPLICATION OF INTEGERS

A **positive** number multiplied by a **negative** number results in a **negative** number.
A **negative** number multiplied by a **negative** number results in a **positive** number.
A **positive** number multiplied by a **positive** number results in a **positive** number.
This is summarised in the table below:

Signs	Product of signs
$(+)\times(+)$	+
$(-)\times(-)$	+

Signs	Product of signs
$(+)\times(-)$	–
$(-)\times(+)$	–

If you multiply two numbers with the same sign the answer is positive.
If you multiply two numbers with different signs the answer is negative.

DIVISION OF INTEGERS

The rules for division are the same as those for multiplication.
A **positive** number divided by a **negative** number results in a **negative** number.
A **negative** number divided by a **negative** number results in a **positive** number.
A **positive** number divided by a **positive** number results in a **positive** number.
This is summarised in the table below:

Signs	division of signs
$(+)\div(+)$	+
$(-)\div(-)$	+

Signs	division of signs
$(+)\div(-)$	–
$(-)\div(+)$	–

If you divide two numbers with the same sign the answer is positive.
If you divide two numbers with different signs the answer is negative.

SQUARES AND CUBES

A **positive** number squared results in a **positive** number.
A **negative** number squared results in a **positive** number.

Signs squared	Square of signs
$(+)^2$	+
$(-)^2$	+

Signs cubed	Cube of signs
$(+)^3$	+
$(-)^3$	–

It is important to note if the sign and number are squared or if only the sign is squared:

$(-5)^2=+25 \rightarrow$ the negative and the 5 is squared

$-5^2=-25 \rightarrow$ only the 5 is squared

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B. ADDITION AND SUBTRACTION OF INTEGERS IN ALGEBRA

REVISION OF ADDITION AND SUBTRACTION OF LIKE TERMS

If you have 3 apples and 2 oranges in a basket and you place an additional 2 apples and 5 oranges in the basket you would have a total of 5 apples and 7 oranges.

The **apples** and **oranges** are considered **like terms**. You can **only add or subtract like terms**. If you have one apple and you add one orange you will have 1 apple and 1 orange.

Let us look at an expression using apples and oranges:

3apples + **2oranges** + **2apples** + **5oranges**

= **5apples** + **7oranges**

The same principle can be applied to variables. **Variables which are the same** are **like terms and can be added together**. Let us look at an equation with variables:

$3x + 2y + 2x + 5y$

$= 5x + 7y$

You can **add the terms with** x in them **together** and you can **add the terms with** y in them **together** as they are **like terms**.

The order in which variables are multiplied does not matter.
This means that xy and yx are like terms and can be added together to give $2xy$.

By convention, variables should be written in alphabetical order.

Like terms must be exactly the same. In other words, x and x^2 are not like terms and cannot be added.

Example 1: Simplify $4x^2 + 7x - 8x^2 + 6x - 3 - 3x^2 + 2$.

$4x^2 + 7x - 8x^2 + 6x - 3 - 3x^2 + 2 \rightarrow$ add like terms

$= -7x^2 + 13x - 1$

Example 2: Simplify $2x + (-3xy) - (-2x) - 6xy - 5$.

$2x + (-3xy) - (-2x) - 6xy - 5$

$= 2x - 3xy + 2x - 6xy - 5 \rightarrow$ add like terms

$= 4x - 9xy - 5$

Example 3: Simplify $4ab - (-2ba) + \left(-3b^2a^2\right) - 6ab - ab$.

$4ab - (-2ba) + \left(-3b^2a^2\right) - 6ab - ab$

$= 4ab + 2ab - 3a^2b^2 - 6ab - ab \rightarrow$ add like terms

$= -ab - 3a^2b^2$

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C. MULTIPLICATION OF INTEGERS IN ALGEBRA

Grade 8 Exponents Recap:
In Grade 8 you learnt that when multiplying like bases, the base is kept the same and the exponents are added:

$$x^a \times x^b = x^{a+b}$$

Example 1: Simplify $2x(-3x)-(-5x)$.

$2x(-3x)-(-5x)$

$=-6x^2+5x \rightarrow$ these are not like terms and cannot be added

Example 2: Simplify $6a(-2ab)+2ab(-3b)$.

$6a(-2ab)+2ab(-3b)$

$=-12a^2b-6ab^2 \rightarrow$ these are not like terms and cannot be added

Example 3: Simplify $2x(-3xy)-(-2x)-6xy(2x)-5x^2$.

$2x(-3xy)-(-2x)-6xy(2x)-5x^2 \rightarrow$ always do brackets first

$=-6x^2y+2x-12x^2y-5x^2 \rightarrow$ add like terms

$=-18x^2y+2x-5x^2$

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Grade 8 Exponents Recap:

When dividing like bases, the base is kept the same and the exponents are subtracted:

$$x^a \div x^b = x^{a-b}$$

Example 1: Simplify $\dfrac{18x^5}{4x^2}$.

$$\frac{\cancel{18}^{9}\,x^{\cancel{5}\,3}}{\cancel{4}^{2}\,\cancel{x^2}} \rightarrow \frac{18}{4} = \frac{9}{2} \quad \text{and} \quad \frac{x^5}{x^2} = x^{5-2} = x^3$$

$$= \frac{9x^3}{2}$$

Example 2: Simplify $\dfrac{-8x^3y^2}{4x^2y}$.

$$\frac{-\cancel{8}^{2}\,x^{\cancel{3}\,1}\,y^{\cancel{2}\,1}}{\cancel{4}^{1}\,\cancel{x^2}\,\cancel{y}} \rightarrow \frac{-8}{4} = -2 \quad \text{and} \quad \frac{x^3}{x^2} = x^1 \quad \text{and} \quad \frac{y^2}{y} = y$$

$$= -2xy$$

Example 3: Simplify $\dfrac{-16a^5b^8}{12a^4b^2}$.

$$\frac{-\cancel{16}^{4}\,a^{\cancel{5}\,1}\,b^{\cancel{8}\,6}}{\cancel{12}^{3}\,\cancel{a^4}\,\cancel{b^2}} \rightarrow \frac{-16}{12} = -\frac{4}{3} \quad \text{and} \quad \frac{a^5}{a^4} = a^1 \quad \text{and} \quad \frac{b^8}{b^2} = b^6$$

$$= \frac{-4ab^6}{3}$$

Example 4: Simplify $\dfrac{2x\left(4y^2\right)+3y\left(-2xy\right)}{2xy^2}$.

$$\frac{2x\left(4y^2\right)+3y\left(-2xy\right)}{2xy^2} \rightarrow \text{simplify the numerator (top) first}$$

$$= \frac{8xy^2 - 6xy^2}{2xy^2} \rightarrow \text{add like terms}$$

$$= \frac{\cancel{2xy^2}}{\cancel{2xy^2}}$$

$$= 1$$

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E. SQUARES AND CUBES OF INTEGERS

Grade 8 Exponents Recap:
In Grade 8 you learnt that when raising an exponent to another exponent, you multiply the exponents:

$$\left(x^a\right)^b = x^{a\times b}$$

Example 1: **Simplify** $2(3x)^2 + 3\left(4y^3\right)^3$.

$2(3x)^2 + 3\left(4y^3\right)^3 \rightarrow$ always do brackets first

$= 2\left(9x^2\right) + 3\left(64y^9\right)$

$= 18x^2 + 192y^9$

Example 2: **Simplify** $\left(3a^2bc\right)^2 + 5a^4(-2bc)^2$.

$\left(3a^2bc\right)^2 + 5a^4(-2bc)^2 \rightarrow$ always do brackets first

$= 9a^4b^2c^2 + 5a^4\left(4b^2c^2\right)$

$= 9a^4b^2c^2 + 20a^4b^2c^2$

$= 29a^4b^2c^2$

Example 3: **Simplify** $\left(3x^2y\right)^2 + 2\left(x^2y\right)^2 - 3x^2(-2xy)^2$.

$\left(3x^2y\right)^2 + 2\left(x^2y\right)^2 - 3x^2(-2xy)^2 \rightarrow$ always do brackets first

$= 9x^4y^2 + 2\left(x^4y^2\right) - 3x^2\left(4x^2y^2\right)$

$= 9x^4y^2 + 2x^4y^2 - 12x^4y^2$

$= -1x^4y^2 \rightarrow$ you don't have to write the 1, $-1x^4y^2$ is the same as $-x^4y^2$

Example 4: **Simplify** $(2pq)^3 + 2pq(3pq)^2 - 3p^3(-2q)^3$.

$(2pq)^3 + 2pq(3pq)^2 - 3p^3(-2q)^3 \rightarrow$ always do brackets first

$= 8p^3q^3 + 2pq\left(9p^2q^2\right) - 3p^3\left(-8q^3\right)$

$= 8p^3q^3 + 18p^3q^3 + 24p^3q^3$

$= 50p^3q^3$

Complete The Mixed Exercise on pages 261 and 262.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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Question 1 : Explained Answers By CAPS AI

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1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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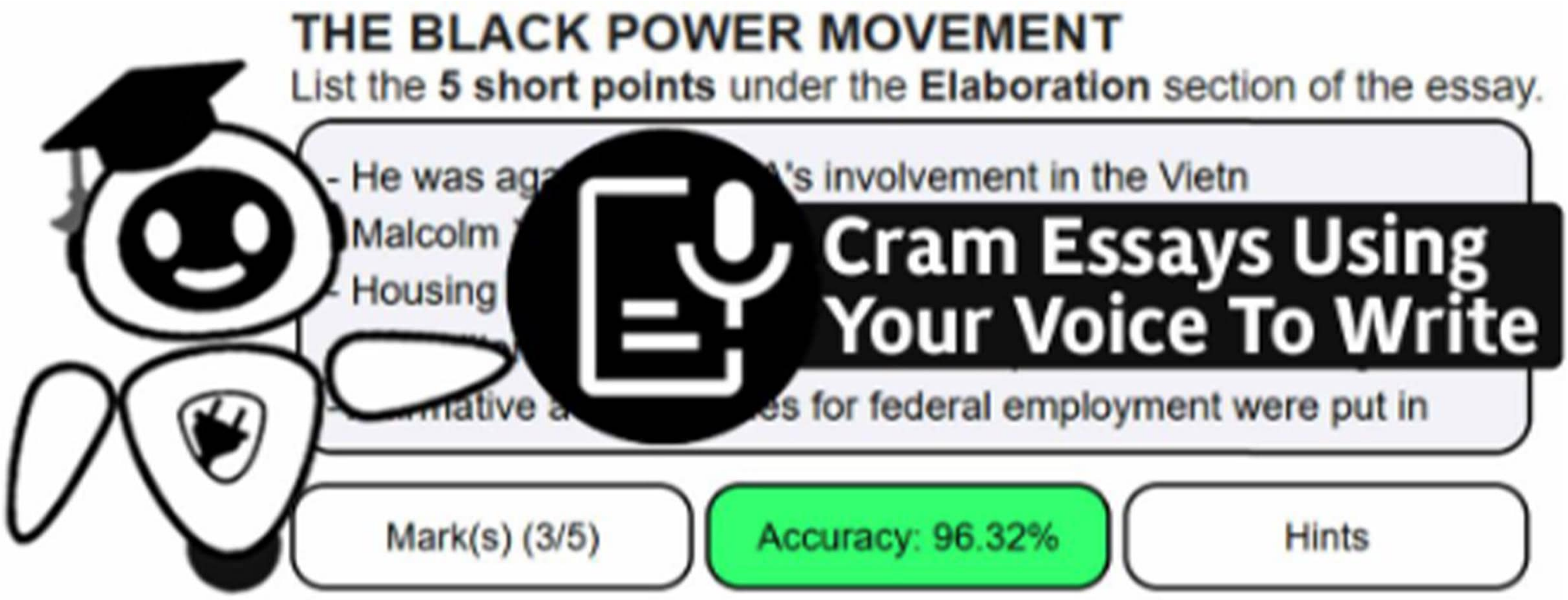

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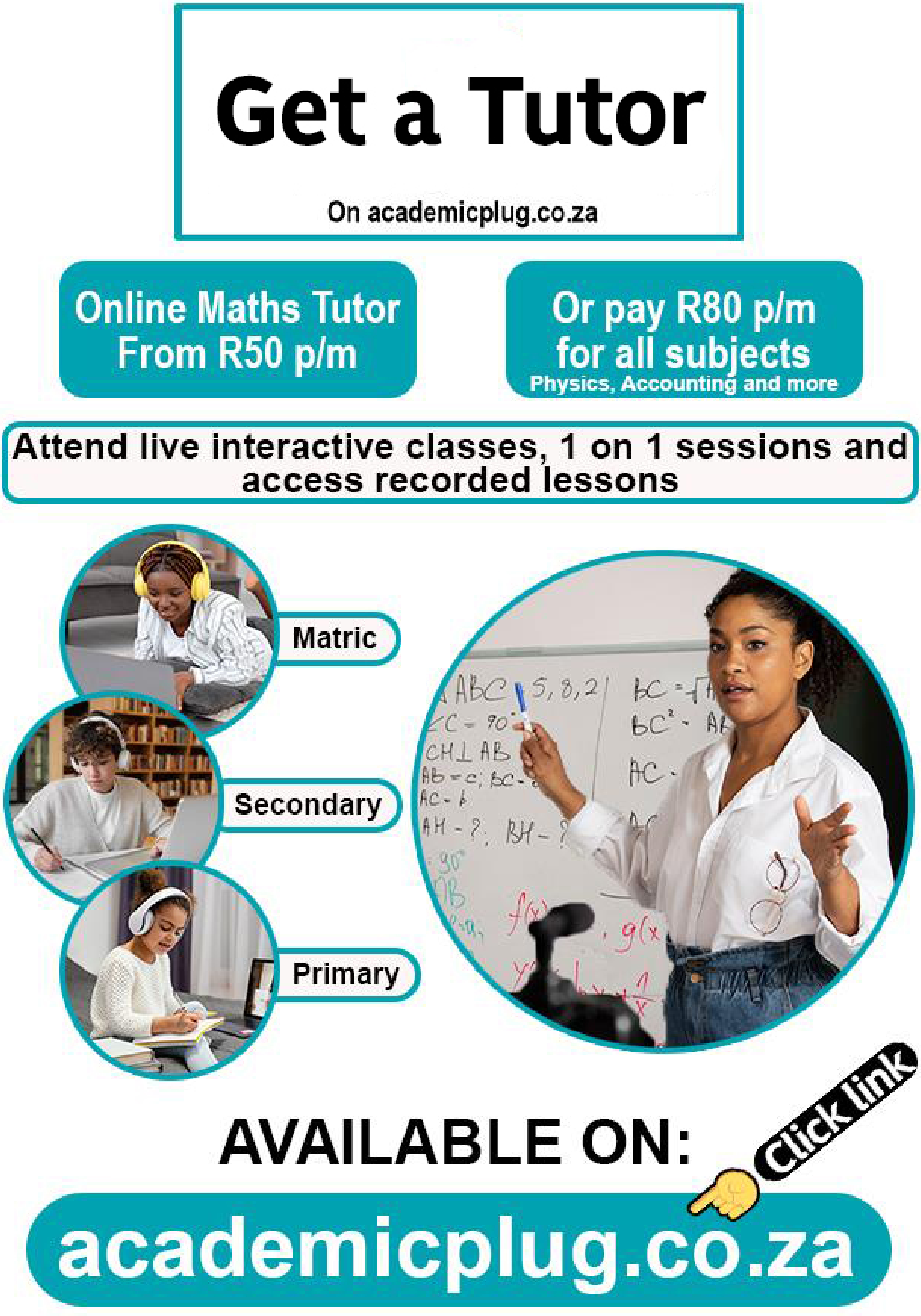

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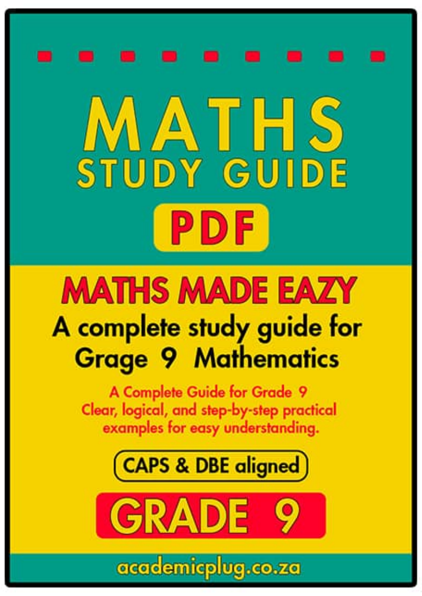

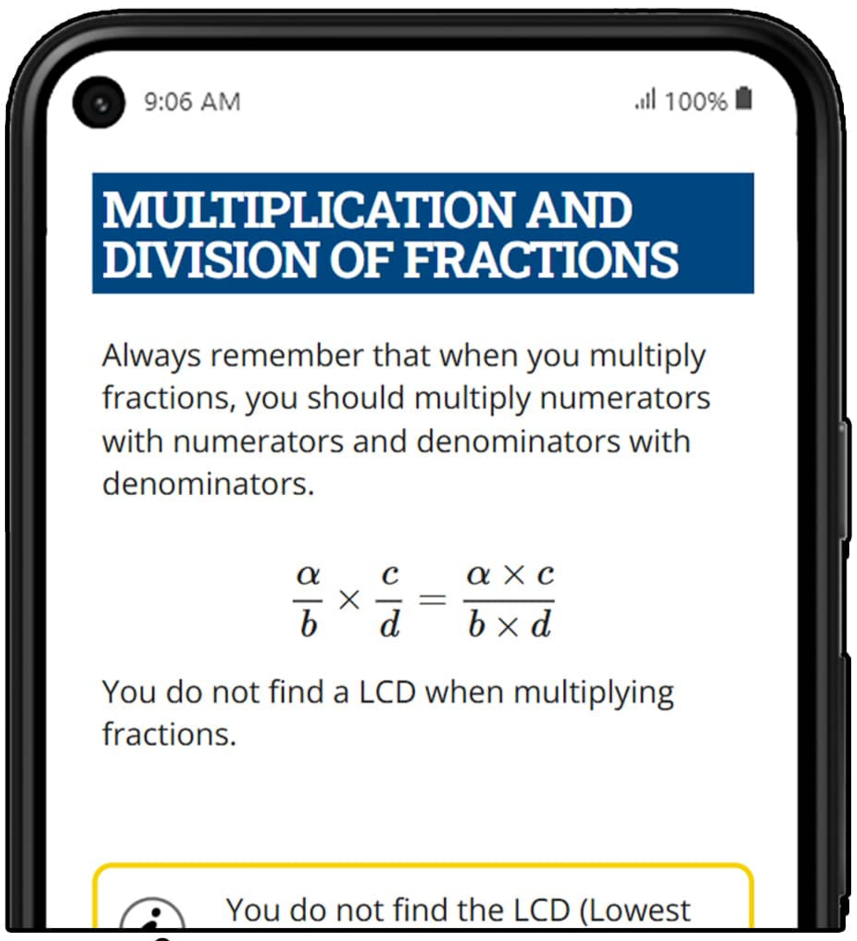

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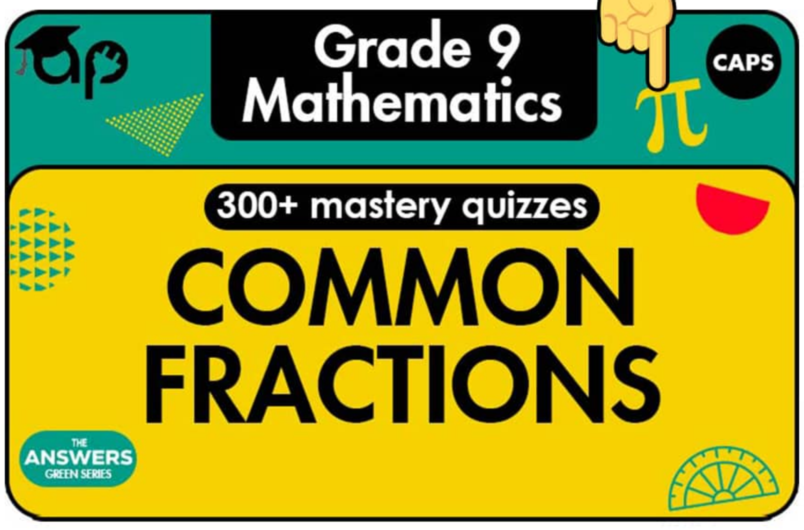

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CHAPTER 3
COMMON FRACTIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
28 30 33 34	A. Addition and Subtraction of Fractions B. Multiplication and Division of Fractions C. Squares, Square Roots, Cubes and Cube Roots D. Percentages	1.4	• Perform all four operations with common fractions and mixed numbers • Perform all four operations, with numbers that involve the squares, cubes, square roots and cube roots of common fractions • Convert mixed numbers to common fractions to perform calculations with them • Use knowledge of multiples and factors to write fractions in the simplest form before or after calculations • Use knowledge of equivalent fractions to add and subtract common fractions • Use knowledge of reciprocal relationships to divide common fractions • Solve problems in contexts involving common fractions, mixed numbers and percentages •

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A. ADDITION AND SUBTRACTION OF FRACTIONS

When **adding** or **subtracting** fractions, they must have the **same denominator**.
If the denominators are different, determine the LCD (Lowest Common Denominator).
When **adding** or **subtracting** fractions **only add or subtract numerators** (the numbers at the top). Do not add the denominators together.
Once you have a LCD keep the denominator the same.

Rule	Explanation
$\frac{a}{c}+\frac{b}{c}=\frac{a+b}{c}$ or $\frac{a}{c}-\frac{b}{c}=\frac{a-b}{c}$	When adding fractions, the denominators must be the same. If the denominators are not the same, find an LCD. Once you have found an LCD, add or subtract the numerators and keep the denominator.

Steps to Converting Mixed Numbers to Improper Fractions:

1. **Multiply the denominator by the whole number and add the answer to the numerator.**
2. **Write the answer obtained in step 1 above, over the original denominator.**

$$a\frac{b}{c}=\frac{(c\times a)+b}{c}$$

Example 1: **Simplify** $2\frac{1}{3}-2\frac{2}{7}$.

$2\frac{1}{3}-2\frac{2}{7}\rightarrow$ convert to improper fractions

$=\frac{7}{3}-\frac{16}{7}\rightarrow LCD=21$

$=\frac{7(7)-3(16)}{21}\rightarrow\frac{7(7)}{3(7)}-\frac{16(3)}{7(3)}$

$=\frac{49-48}{21}$

$=\frac{1}{21}$

Example 2: **Simplify** $\frac{2}{3}+\frac{4}{2}-\frac{2}{8}$.

$\frac{2}{3}+\frac{4}{2}-\frac{2}{8}\rightarrow LCD=24$

$=\frac{8(2)+12(4)-3(2)}{24}\rightarrow\frac{2(8)}{3(8)}-\frac{4(12)}{2(12)}-\frac{2(3)}{8(3)}$

$=\frac{16+48-6}{24}$

$=\frac{58}{24}$

$=\frac{29}{12}$

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Example 1: Simplify $\frac{3x}{5}+\frac{7x}{2}-\frac{3}{2}$.

$$\frac{3x}{5}+\frac{7x}{2}-\frac{3}{2} \rightarrow \text{LCD} = 10$$

$$=\frac{2(3x)+5(7x)-5(3)}{10} \rightarrow \frac{3x(2)}{5(2)}+\frac{7x(5)}{2(5)}-\frac{3(5)}{2(5)}$$

$$=\frac{6x+35x-15}{10} \rightarrow \text{add like terms}$$

$$=\frac{41x-15}{10}$$

Example 2: Simplify $\frac{x}{3}-\frac{3}{2}-\frac{2x}{2}+\frac{2}{3}+2$.

$$\frac{x}{3}-\frac{3}{2}-\frac{2x}{2}+\frac{2}{3}+2 \rightarrow \text{LCD} = 6$$

$$=\frac{2x-3(3)-2x(3)+2(2)+2(6)}{6}$$

$$=\frac{2x-9-6x+4+12}{6} \rightarrow \text{add like terms}$$

$$=\frac{-4x+7}{6}$$

Example 3: Simplify $\frac{p}{2p}-2-\frac{2p}{3}+\frac{3}{2}-p$.

$$\frac{p}{2p}-2-\frac{2p}{3}+\frac{3}{2}-p \rightarrow \text{LCD} = 6p$$

$$=\frac{p(3)-2(6p)-2p(2p)+3(3p)-p(6p)}{6p}$$

$$=\frac{3p-12p-4p^2+9p-6p^2}{6p} \rightarrow \text{add like terms}$$

$$=\frac{-10p^{\not{2}}}{6\not{p}}$$

$$=\frac{-5p}{3}$$

Example 4: Simplify $\frac{3}{5x}-\frac{y}{4}+\frac{5}{4}-2y$.

$$\frac{3}{5x}-\frac{y}{4}+\frac{5}{4}-2y \rightarrow \text{LCD} = 20x$$

$$=\frac{3(4)-y(5x)+5(5x)-2y(20x)}{20x}$$

$$=\frac{12-5xy-25x-40xy}{20x} \rightarrow \text{add like terms}$$

$$=\frac{12-45xy-25x}{20x}$$

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B. MULTIPLICATION AND DIVISION OF FRACTIONS

When multiplying fractions, **multiply numerators** with **numerators** and **denominators** with **denominators**.

$$\frac{a}{b}\times\frac{c}{d}=\frac{a\times c}{b\times d}$$

You do not find a LCD when multiplying fractions.

Dividing a fraction is the same as multiplying by the reciprocal.

For example, dividing 10 by 2 is the same as multiplying 10 by $\frac{1}{2}$.

When dividing fractions, you use the **'Tip and Times' rule**:

$$\frac{a}{b}\div\frac{x}{y}=\frac{a}{b}\times\frac{y}{x}$$

Always 'tip and times' the fraction after the divide sign.

Rule	Explanation
$\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd}$	Multiply numerators with numerators and denominators with denominators. It is often easier to cross cancel denominators with numerators if they have a HCF.
$\frac{a}{b}\div\frac{c}{d}=\frac{a}{b}\times\frac{d}{c}=\frac{ad}{bc}$	When dividing fractions '**tip and times**'. Always tip the fraction after divide sign.

Example 1: **Simplify** $\frac{3x}{5y}\times\frac{25x}{9}$.

$$\frac{3x}{5y}\times\frac{25x}{9}$$

$$=\frac{\cancel{3}^{1}x}{\cancel{5}_{1}y}\times\frac{\cancel{25}^{5}x}{\cancel{9}_{3}}$$

$$=\frac{5x^2}{3y}$$

Example 2: **Simplify** $\frac{5a}{14b}\times\frac{3b}{8}\times\frac{7}{9a}$.

$$\frac{5a}{14b}\times\frac{3b}{8}\times\frac{7}{9a}$$

$$=\frac{5\cancel{a}^{1}}{\cancel{14}^{2}\cancel{b}^{1}}\times\frac{\cancel{3}^{1}\cancel{b}^{1}}{8}\times\frac{\cancel{7}^{1}}{\cancel{9}^{3}\cancel{a}^{1}}$$

$$=\frac{5}{2\times8\times3}$$

$$=\frac{5}{48}$$

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Order of Operations Recap:
BODMAS
Operations should always be performed in the order of
Brackets, Of, Divide, Multiply, Add, Subtract
(Remember that 'Of' means multiply)

Example 3: Simplify $\dfrac{2x}{6y^2} \div \dfrac{8x}{3y} \times \dfrac{3}{5}$.

$$\left(\frac{2x}{6y^2} \div \frac{8x}{3y}\right) \times \frac{3}{5} \rightarrow \text{do division first, tip and times}$$

$$= \frac{2x}{6y^2} \times \frac{3y}{8x} \times \frac{3}{5}$$

$$= \frac{\cancel{2}\,\cancel{x}}{\cancel{6}^{2}\,y^{\cancel{2}1}} \times \frac{\cancel{3}\,\cancel{y}}{\cancel{8}^{4}\,\cancel{x}} \times \frac{3}{5}$$

$$= \frac{3}{2 \times y \times 4 \times 5}$$

$$= \frac{3}{40y}$$

Example 4: Simplify $\dfrac{5x}{3y} + \dfrac{3}{5y} \div \dfrac{2}{2y}$.

$$\frac{5x}{3y} + \left(\frac{3}{5y} \div \frac{2}{2y}\right) \rightarrow \text{do division first, tip and times}$$

$$= \frac{5x}{3y} + \left(\frac{3}{5\cancel{y}} \times \frac{\cancel{2}\,\cancel{y}}{\cancel{2}}\right)$$

$$= \frac{5x}{3y} + \frac{3}{5} \rightarrow \text{LCD} = 15y$$

$$= \frac{5(5x) + 3y(3)}{15y}$$

$$= \frac{25x + 9y}{15y}$$

Example 5: Simplify $\dfrac{3a}{2b} \div \dfrac{4b}{3a} \div \dfrac{5}{3}$.

$$\left(\frac{3a}{2b} \div \frac{4b}{3a}\right) \div \frac{5}{3} \rightarrow \text{when there is repeated division, work in order from left to right}$$

$$= \left(\frac{3a}{2b} \times \frac{3a}{4b}\right) \div \frac{5}{3}$$

$$= \frac{9a^2}{8b^2} \times \frac{3}{5}$$

$$= \frac{27a^2}{40b^2}$$

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Example 6: Simplify $\dfrac{\frac{2x}{3}+\frac{3}{4}}{\frac{5}{3}-\frac{1}{2}}$.

$\dfrac{\frac{2x}{3}+\frac{3}{4}}{\frac{5}{3}-\frac{1}{2}} \rightarrow$ when you have fractions over fractions rewrite the fraction with $\div$ sign

$\left(\frac{2x}{3}+\frac{3}{4}\right)\div\left(\frac{5}{3}-\frac{1}{2}\right) \rightarrow$ find an LCD for each bracket

$=\left(\frac{8x+9}{12}\right)\div\left(\frac{10-3}{6}\right)$

$=\left(\frac{8x+9}{12}\right)\div\left(\frac{7}{6}\right) \rightarrow$ now tip and times

$=\frac{8x+9}{\cancel{12}^{2}}\times\frac{\cancel{6}}{7}$

$=\frac{8x+9}{14}$

Example 7: Simplify $\frac{2}{5}\div\frac{2}{3}$ of $\frac{5}{3}$.

$\frac{2}{5}\div\left(\frac{2}{3} \text{ of } \frac{5}{3}\right) \rightarrow$ do 'of' before division, 'of' means multiply

$=\frac{2}{5}\div\left(\frac{2}{3}\times\frac{5}{3}\right)$

$=\frac{2}{5}\div\frac{10}{9} \rightarrow$ tip and times

$=\frac{\cancel{2}}{5}\times\frac{9}{\cancel{10}^{5}}$

$=\frac{9}{25}$

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C. SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

Example 1: Simplify $\left(\dfrac{2a}{3b^3}\right)^2 \times \left(\dfrac{a}{2b^2}\right)^3$.

$$\left(\frac{2a}{3b^3}\right)^2 \times \left(\frac{a}{2b^2}\right)^3$$

$$= \frac{(2a)^2}{(3b^3)^2} \times \frac{(a)^3}{(2b^2)^3} \rightarrow \text{square and cube the top and bottom individually}$$

$$= \frac{4a^2}{9b^6} \times \frac{a^3}{8b^6}$$

$$= \frac{\cancel{4}a^2}{9b^6} \times \frac{a^3}{\cancel{8}^2 b^6}$$

$$= \frac{a^5}{18b^{12}}$$

Recap:

$$\left(\frac{x^a}{x^b}\right)^2 = \frac{x^{a\times 2}}{x^{b\times 2}} \quad \text{and} \quad \left(\frac{x^a}{x^b}\right)^3 = \frac{x^{a\times 3}}{x^{b\times 3}}$$

Example 2: Simplify $\sqrt[3]{\dfrac{8x^9}{27y^{15}}}$.

$$\sqrt[3]{\frac{8x^9}{27y^{15}}} \rightarrow \text{cube root the top and bottom individually}$$

$$= \frac{\sqrt[3]{8x^9}}{\sqrt[3]{27y^{15}}} \rightarrow \text{when cube rooting divide all exponents by 3}$$

$$= \frac{2x^3}{3y^5}$$

Example 3: Simplify $\sqrt{\dfrac{25x^8}{49y^{12}}}$.

$$\sqrt{\frac{25x^8}{49y^{12}}} \rightarrow \text{when square rooting divide all exponents by 2}$$

$$= \frac{5x^4}{7y^6}$$

Recap:

$$\sqrt{\frac{x^a}{x^b}} = \frac{x^{a\div 2}}{x^{b\div 2}} \quad \text{and} \quad \sqrt[3]{\frac{x^a}{x^b}} = \frac{x^{a\div 3}}{x^{b\div 3}}$$

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Example 4: **Simplify** $\sqrt{x^2-\left(\frac{4x}{5}\right)^2}$.

$\sqrt{x^2-\left(\frac{4x}{5}\right)^2}$ $\rightarrow$ do not sqaure root over a '+' or '−' sign, simplify first

$=\sqrt{x^2-\frac{16x^2}{25}}$ $\rightarrow$ LCD = 25

$=\sqrt{\frac{25x^2-16x^2}{25}}$

$=\sqrt{\frac{9x^2}{25}}$

$=\frac{3x}{5}$

D. PERCENTAGES

Recap:
Percentage means part out of 100 and is exactly the same as a fraction with a denominator (bottom) of 100.

Example 1: **Write 52% as a fraction in its simplest form.**

$52\% = \frac{52}{100}$ $\rightarrow$ percent means divide the number by 100

$= \frac{13}{25}$ $\rightarrow$ 4 goes into 52 thirteen times and into 100 twenty five times

Example 2: **A recipe for 600*g* of butter icing is made of 35% butter and 65% icing sugar. How many grams of each ingredient is required?**

Butter:

$600\times\frac{35}{100}$

$=210\,g$ of butter

Icing Sugar:

$600\times\frac{65}{100}$

$=390\,g$ icing sugar

Complete The Mixed Exercise on page 266 and 267.

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LIFE ORIENTATION

REVISION BOOKLET

TERM 2

2024

GRADE 12

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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Question 1 : Explained Answers By CAPS AI

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1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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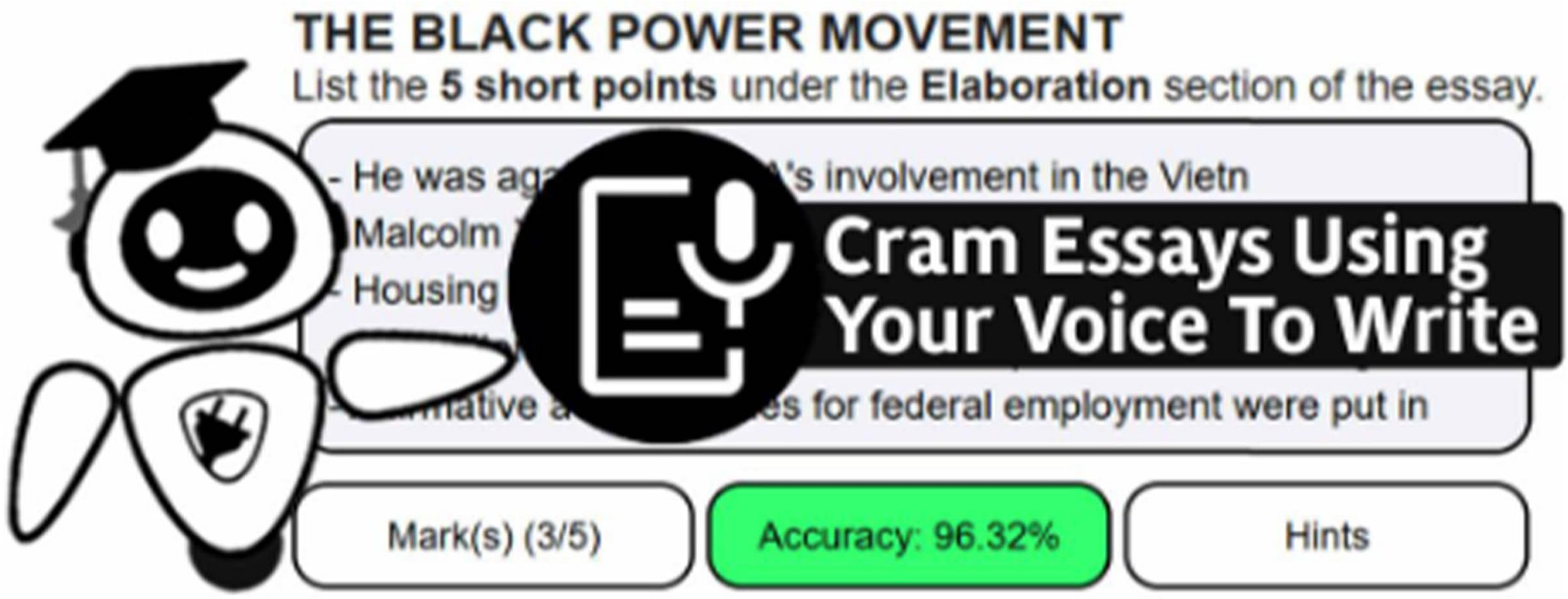

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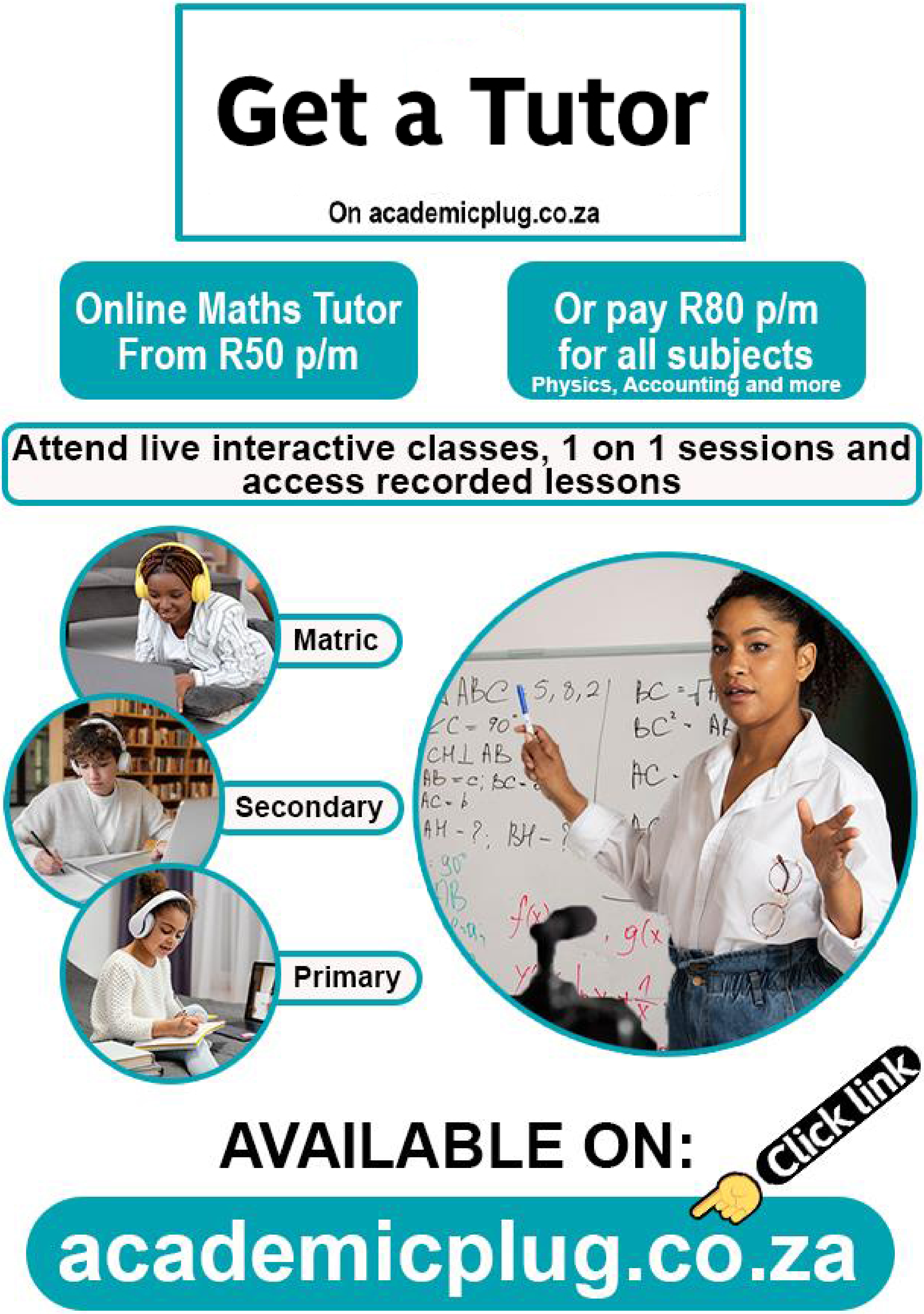
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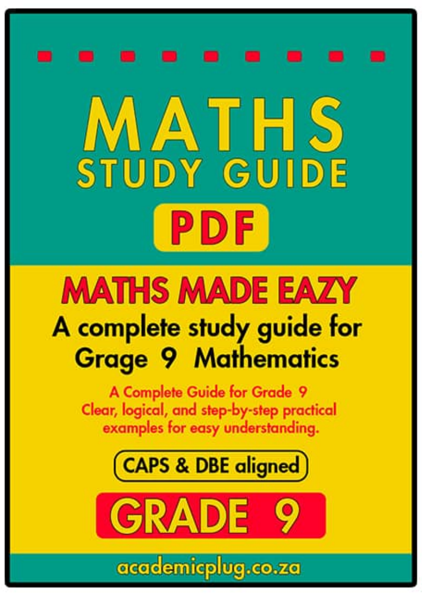

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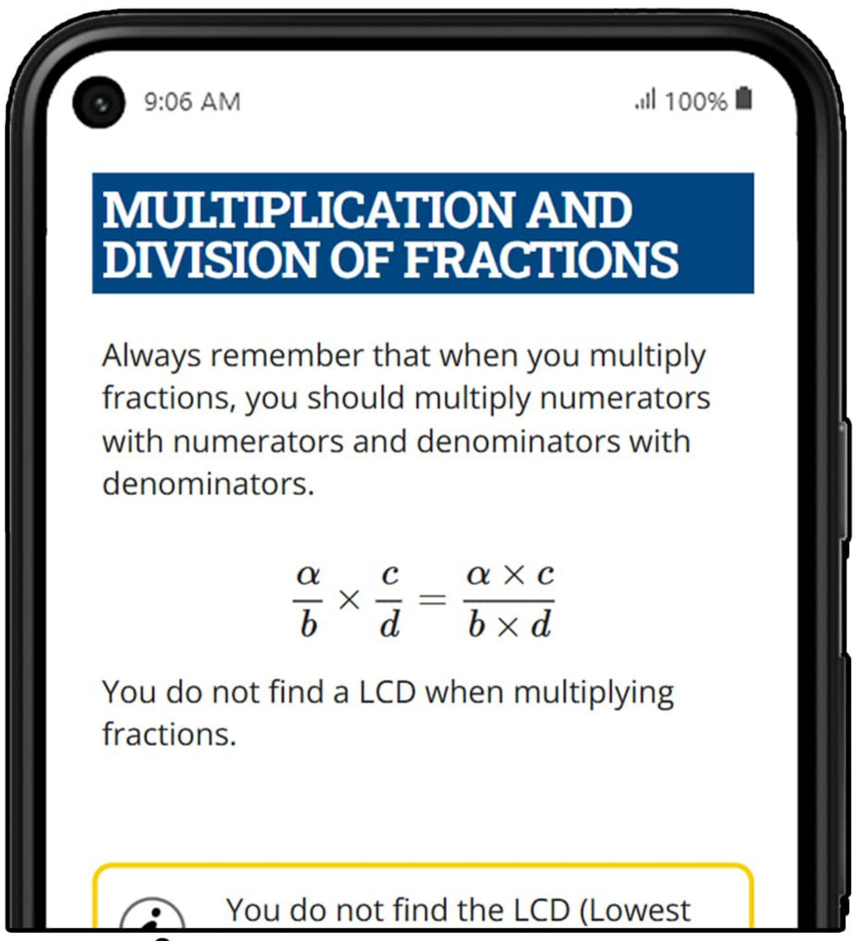

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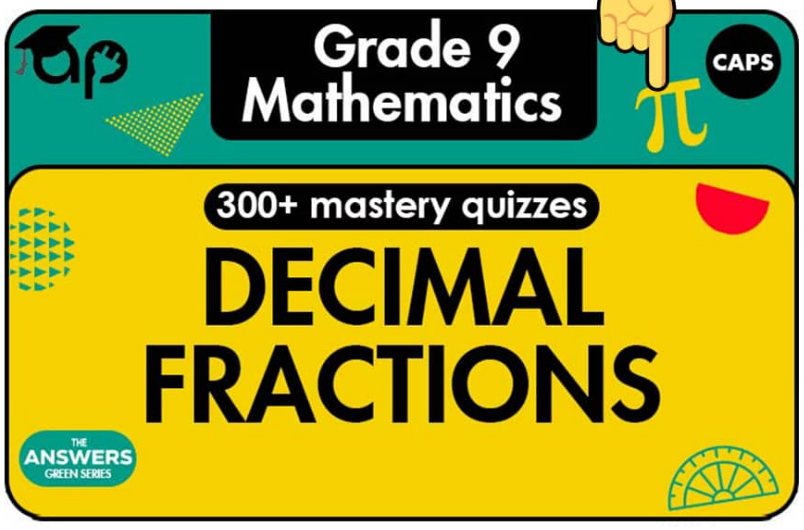

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CHAPTER 4
DECIMAL FRACTIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
36 36 37 37 39	**A. Decimal Fractions** • Reading and Writing Decimal Fractions **B. Addition and Subtraction of Decimal Fractions** **C. Multiplication and Division of Decimal Fractions** **D. Squares, Cubes, Square Roots and Cube Roots**	1.5	• Perform calculations using multiple operations with decimal fractions, using a calculator where appropriate • Perform calculations using multiple operations, with or without brackets, with numbers that involve the squares, cubes, square roots and cube roots of decimal fractions • Solve problems in context involving decimal fractions

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A. DECIMAL FRACTIONS REVISION

A **decimal fraction** is a **fraction** where the **denominator** is a **power of 10**.
In other words, the denominator is 10 or 100 or 1000 etc.

READING AND WRITING DECIMAL FRACTIONS

Examine the number 12,356. The table below shows how the number is broken up according to the decimal place value system.

Tens	Units	Decimal Comma	Tenths	Hundredths	Thousandths
1	2	,	3	5	6

Each number after the decimal comma increases the denominator by a factor of 10. If there is 1 number after the comma the denominator is 10. If there are 2 numbers after the comma the denominator is 100 and so on.

$0,3=\frac{3}{10}\rightarrow$ one decimal place shows a denominator of 10

$0,32=\frac{32}{100}\rightarrow$ two decimal places shows a denominator of 100

$0,325=\frac{325}{1000}\rightarrow$ three decimal places shows a denominator of 1000

In order to **write a fraction as a decimal number**, you have to **write the number as an equivalent fraction** with a **denominator** that is a **power of 10**.

<u>Example</u>: Write the fraction $\frac{3}{4}$ as a decimal number.

To write the fraction as decimal, multiply the numerator and denominator by 25 in order to obtain a denominator of 100. This is the lowest power of 10 which is divisible by 4.

$\frac{3}{4}\times\frac{25}{25}\rightarrow$ top and bottom are multiplied by 25 to obtain a denominator of 100

$=\frac{75}{100}\rightarrow$ there are 2 numbers after the decimal place

$=0,75$

If a denominator cannot be expressed as a power of 10 the resulting decimal will be a recurring fraction. For example, the number $\frac{1}{3}=0,33333...$

A dot on top of a number indicates a recurring number. The above fraction can be written as $\frac{1}{3}=0,\dot{3}$.

If there are 2 numbers recurring such as $\frac{1}{11}=0,090909...$ a dot is placed on top of each of the recurring numbers, this means $\frac{1}{11}=0,\dot{0}\dot{9}$

If there are many numbers recurring the dot can be placed on top of the first and last number of the pattern. So the number $\frac{3125}{9999}=0,312531253125...$ can be written as $\frac{3125}{9999}=0,\dot{3}12\dot{5}$.

Complete Exercise 1 on page 271.

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B. ADDITION AND SUBTRACTION OF DECIMAL FRACTIONS

When **adding** or **subtracting decimal fractions** without a calculator, **write the decimals as a fraction with a denominator which is a power of 10**.
The number of zeroes the denominator has, must be equal to **the largest number** of **decimal places**.

Example 1: Calculate the value of 1,82*x* + 3,4*y* + 0,53*x* – 2,2*y* without the use of a calculator.

$1,82x + 3,4y + 0,53x - 2,2y \rightarrow$ largest decimal place = 2, $\therefore$ write the fractions over 100

$= \frac{182x}{100} + \frac{340y}{100} + \frac{53x}{100} - \frac{220y}{100} \rightarrow$ add like terms

$= \frac{235x}{100} + \frac{120y}{100}$

$= 2,35x + 1,2y$

Variables such as *x* and *y* do not add to the count of decimal places. In other words, the numbers 0,2 and 0,2*x* both have 1 decimal place as 0,2*x* is the same as 0,2 × *x*.

Example 2: Calculate the value of 0,305*xy* – 0,23*x* + 1,2*xy* + *x* without the use of a calculator.

$0,305xy - 0,23x + 1,2xy + x \rightarrow$ largest decimal place = 3, $\therefore$ write the fractions over 1000

$= \frac{305xy}{1000} - \frac{230x}{1000} + \frac{1200xy}{1000} + \frac{1000x}{1000} \rightarrow$ add like terms

$= \frac{1505xy}{1000} - \frac{770x}{1000}$

$= 1,505xy - 0,77x$

Complete Exercise 2 on page 271.

C. MULTIPLICATION AND DIVISION OF DECIMAL FRACTIONS

Recap:
When multiplying by a power of 10, the decimal comma moves to the right.
When dividing by a power of 10, the decimal comma moves to the left.

Example 1: Calculate the value of 4,23 × 10 without using a calculator.

$4,23 \times 10 \rightarrow$ move the decimal comma 1 place right

$= 42,3$

Example 2: Calculate the value of 4,23 × 100 without using a calculator.

$4,23 \times 100 \rightarrow$ move the decimal comma 2 places right

$= 423$

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Example 3: **Calculate the value of 4,23 ÷ 10 without using a calculator.**

$4,23 \div 10 \rightarrow$ move the decimal comma 1 place left

$= 0,423 \rightarrow$ you must write the 0 as a place holder, you cannot write ,423 without the 0

Example 4: **Calculate the value of 4,23 ÷ 100 without using a calculator.**

$4,23 \div 100 \rightarrow$ move the decimal point 2 places left

$= 0,0423 \rightarrow$ you must write both zeroes as a place holder

Example 5: **Calculate the value of $0,31x \times 0,2y$ without using a calculator.**

Method 1: Write the decimals as a fraction

$0,31x \times 0,2y \rightarrow$ write all of the decimals with a denominator that is a power of 10

$$= \frac{31x}{100} \times \frac{2y}{10}$$

$$= \frac{62xy}{1000}$$

$$= 0,062xy$$

Method 2: Ignore the decimal comma and multiply the numbers. The answer will have the same number of decimal places as the total number of decimal places in the numbers being multiplied.

$0,31x \times 0,2y \rightarrow$ ignore the decimal comma and mulitply $31x$ and $2y$ together

$31x \times 2y$

$= 62xy \rightarrow$ now put back the decimal comma

$\therefore 0,31x \times 0,2y = 0,062xy \rightarrow$ there were a total of 3 decimal places in the original sum

Example 6: **Calculate the value of $0,9x \times 0,4x$ without using a calculator.**

Method 1: Write the decimals as a fraction

$0,9x \times 0,4x \rightarrow$ write all of the decimals with a denominator that is a power of 10

$$= \frac{9x}{10} \times \frac{4x}{10}$$

$$= \frac{36x^2}{100}$$

$$= 0,36x^2$$

Method 2: Ignore the decimal comma and multiply the numbers. The answer will have the same number of decimal places as the total number of decimal places in the numbers being multiplied.

$0,9x \times 0,4x \rightarrow$ ignore the decimal comma and mulitply $9x$ and $4x$ together

$9x \times 4x$

$= 36x^2 \rightarrow$ now put back the decimal

$\therefore 0,9x \times 0,4x = 0,36x^2 \rightarrow$ there were a total of 2 decimal places in the original sum

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<u>Example 7</u>: Calculate the value of $48x \div 0{,}6y$ without using a calculator.

$48x \div 0{,}6y \rightarrow$ write the decimal with a denominator that is a power of 10

$= \frac{48x}{1} \div \frac{6y}{10} \rightarrow$ tip and times

$= \frac{\cancel{48}^{8}x}{1} \times \frac{10}{\cancel{6}^{1}y}$

$= \frac{80x}{y}$

<u>Example 8</u>: Calculate the value of $0{,}48p \div 0{,}6q$ without using a calculator.

$0{,}48p \div 0{,}6q \rightarrow$ write all the decimals with a denominator that is a power of 10

$= \frac{48p}{100} \div \frac{6q}{10} \rightarrow$ tip and times

$= \frac{\cancel{48}^{8}p}{\cancel{100}^{10}} \times \frac{\cancel{10}^{1}}{\cancel{6}^{1}q}$

$= \frac{8p}{10q}$

$= \frac{4p}{5q}$

Complete Exercise 3 on page 271.

D. SQUARES, CUBES, SQUARE ROOTS AND CUBE ROOTS

When squaring, cubing or rooting decimal fractions, convert the decimal fraction into a common fraction by writing the decimal with a denominator that is a power of 10. Once you have a common fraction, all of the rules for squaring, cubing, or rooting that you have learnt still apply.

<u>Example 1</u>: Calculate the value of $\sqrt{0{,}16x^4}$ without using a calculator.

$\sqrt{0{,}16x^4} \rightarrow$ write the decimal with a denominator of 100

$= \sqrt{\frac{16x^4}{100}} \rightarrow$ square root the numerator and denominator seperately

$= \frac{4x^2}{10}$

$= 0{,}4x^2$

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<u>Example 2</u>: Calculate the value of $\sqrt[3]{0,027x^6}+(0,2x)^2$ without using a calculator.

$\sqrt[3]{0,027x^6}+(0,2x)^2$ → write the decimals with denominators that are powers of 10

$$=\sqrt[3]{\frac{27x^6}{1000}}+\left(\frac{2x}{10}\right)^2$$

$$=\frac{3x^2}{10}+\frac{4x^2}{100} \rightarrow \text{LCD}=100$$

$$=\frac{30x^2+4x^2}{100}$$

$$=\frac{34x^2}{100}$$

$$=0,34x^2$$

<u>Example 3</u>: Calculate the value of $\sqrt[3]{0,008x^9}\div(0,2x)^3$ without using a calculator.

$\sqrt[3]{0,008x^9}\div(0,2x)^3$ → write the decimals with denominators that are powers of 10

$$=\sqrt[3]{\frac{8x^9}{1000}}\div\left(\frac{2x}{10}\right)^3$$

$$=\frac{2x^3}{10}\div\frac{8x^3}{1000} \rightarrow \text{tip and times}$$

$$=\frac{\cancel{2}^1\,\cancel{x^3}}{\cancel{10}^1}\times\frac{\cancel{1000}^{100}}{\cancel{8}^4\,\cancel{x^3}}$$

$$=\frac{100}{4}$$

$$=25$$

There is no solution to the square root of a negative number.

Complete Exercise 4 on pages 271 and 272 and the Mixed Exercise on page 272.

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Democracy and Human Rights

Question 1

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B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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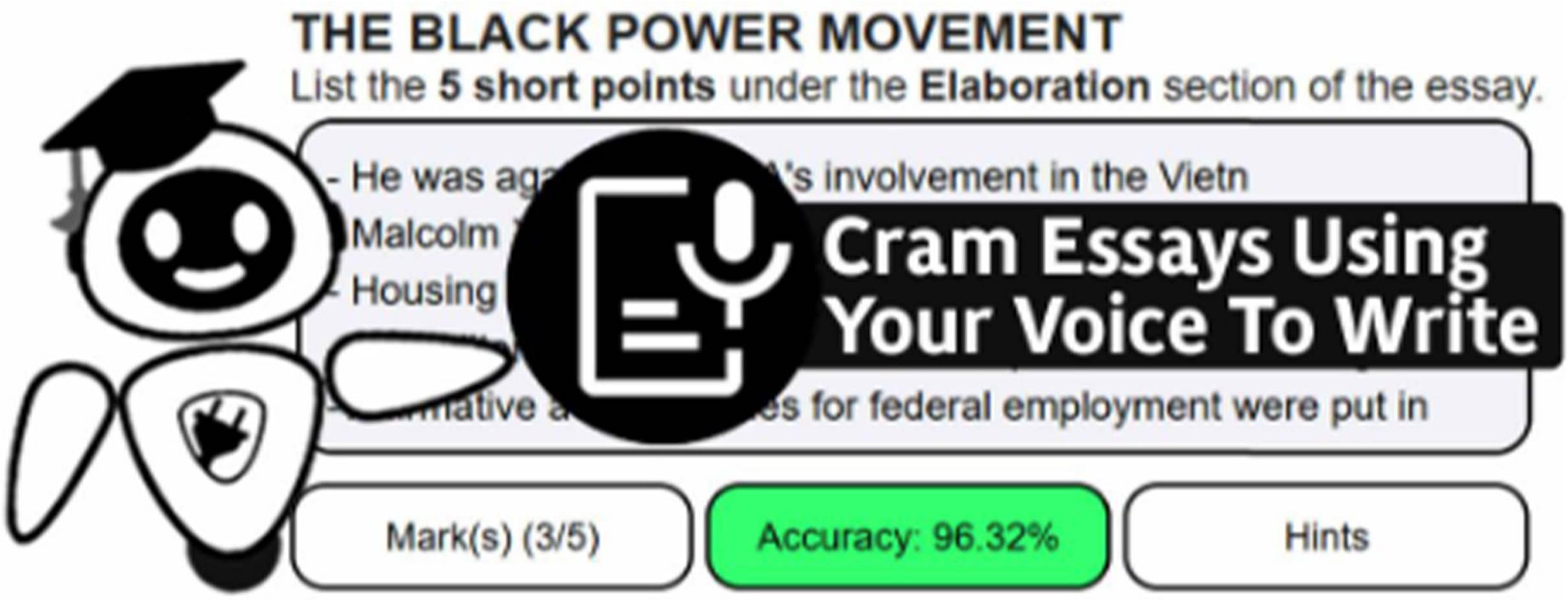

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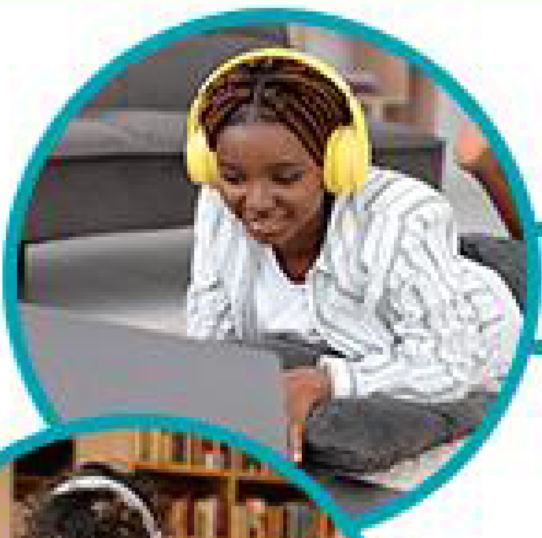

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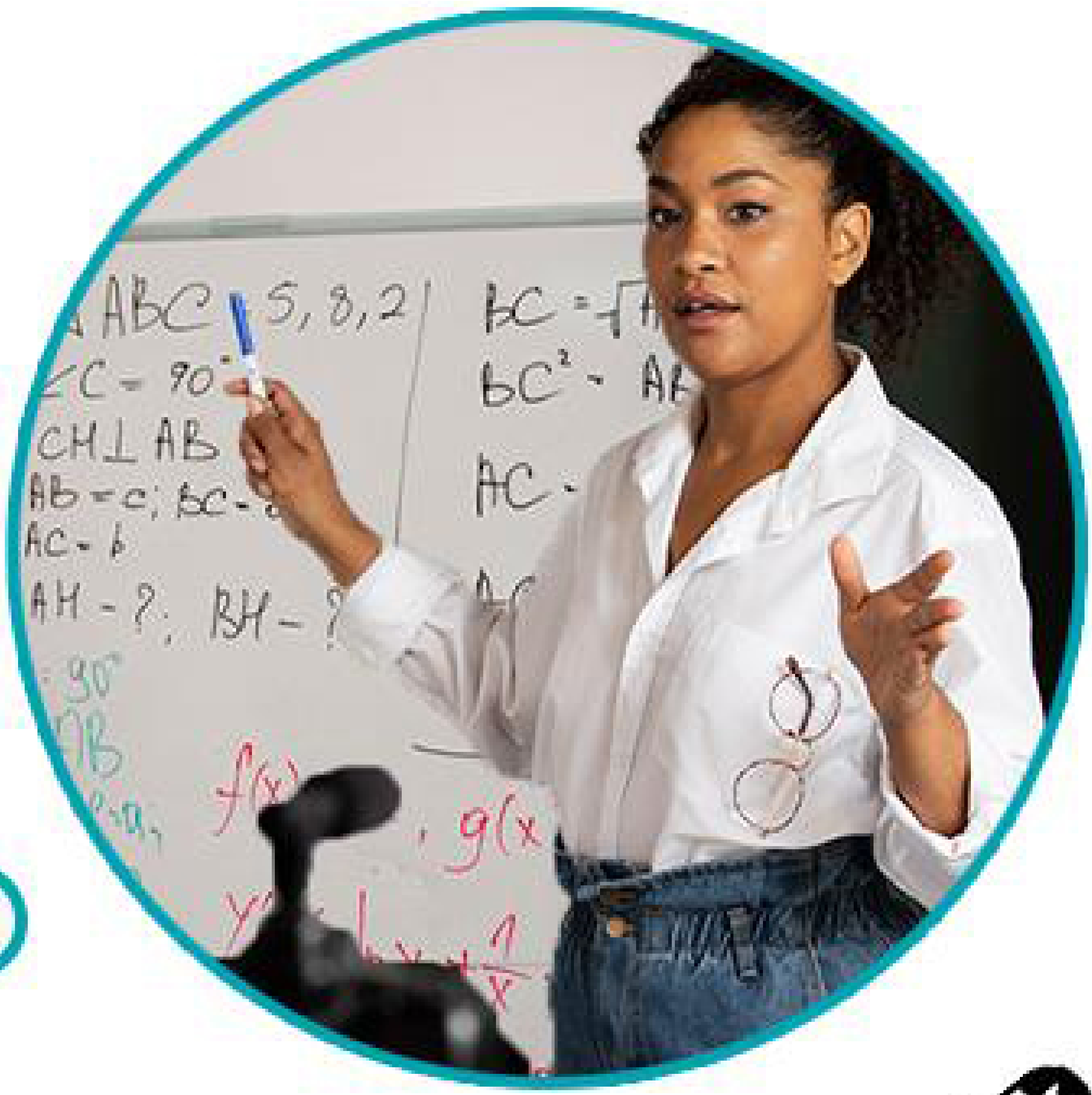

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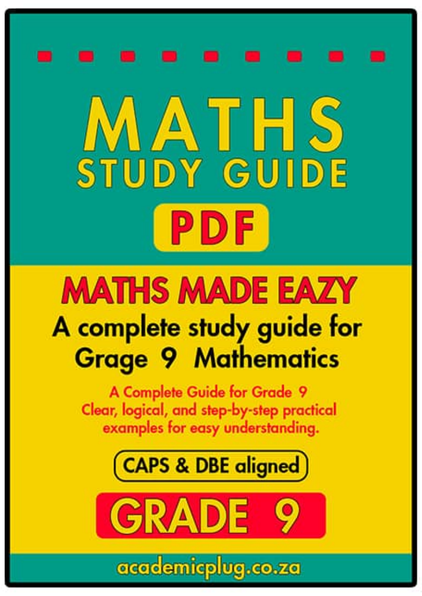

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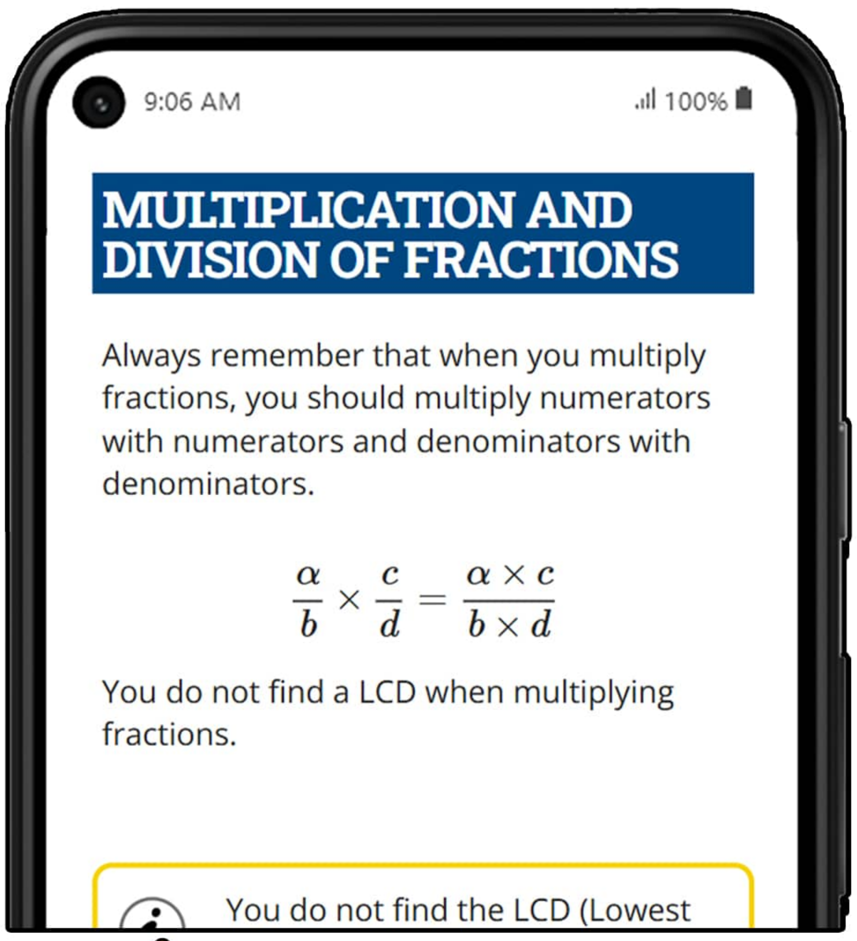

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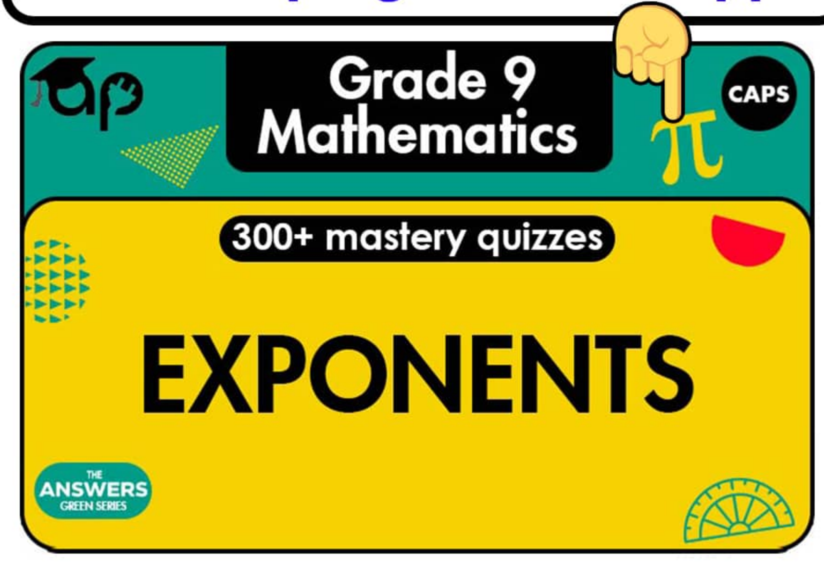

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CHAPTER 5 - EXPONENTS

WHAT YOU WILL LEARN IN THIS CHAPTER

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A. GRADE 8 EXPONENT REVISION

Exponents are shorthand notation for expressing how many times a number is multiplied by itself. In Chapter 1, it was seen that $2\times2\times2=2^3$. The number 2^3 is written in exponential form and is read as 2 raised to the power of 3.
Exponential notation is shown below.

Notation: Power $\{2^{3}$ (3 → Exponent, 2 → Base) $\longrightarrow$ b^{x} (x → Exponent, b → Base) $\}$ Power

In exponential notation b is known as the base and x is called the exponent or index.
In the above example the number 2 is the base and 3 is the exponent or index.
The value of the power is $2\times2\times2=8$.

A number raised to the power of 2, such as 5^2 is also read as five squared.
A number raised to the power of 3, such as 5^3 is also read as five cubed.

LAW 1: MULTIPLICATION OF EXPONENTS

When multiplying numbers with the same base, the base remains the same and you add the exponents.

$$a^x \times a^y = a^{x+y}$$

LAW 2: DIVISION OF EXPONENTS

When dividing numbers with the same base, the base remains the same and you subtract the exponents.

$$a^x \div a^y = a^{x-y} \quad \text{or} \quad \frac{a^x}{a^y} = a^{x-y}$$

Assume that variables in the denominator are not equal to zero.

LAW 3: THE ZERO EXPONENT

Any number raised to the power of 0 is equal to 1.

$$a^0 = 1$$

A restriction on this law is that a cannot be equal to 0.

LAW 4: RAISING A POWER TO ANOTHER POWER

When a power is raised to a further power you multiply the exponents.

$$\left(a^x\right)^y = a^{x\times y}$$

Example 1: Simplify the following:

a) $3x^3\times4x^6$

b) $2x^3y^2\times5x^7y^3$

c) $-2p^3q^2\times3pq$

d) $-4^8x^3y^2\times-4^5x^4y$

a) $3x^3\times4x^6$ → multiply the coefficients first, then add the exponents of each base

$=12x^{3+6}$

$=12x^9$

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b) $2x^3y^2 \times 5x^7y^3 \rightarrow$ multiply the coefficients first, then add the exponents of each base

$= 10x^{3+7}y^{2+3}$

$= 10x^{10}y^5$

c) $-2p^3q^2 \times 3pq \rightarrow$ multiply the coefficients first, then add the exponents of each base

$= -6p^{3+1}q^{2+1} \rightarrow$ don't forget that a '$-$' $\times$ '$+$' is a '$-$'

$= -6p^4q^3$

d) $-4^8x^3y^2 \times -4^5x^4y \rightarrow$ multiply the coefficients first, then add the exponents of each base

$= 4^{8+5}x^{3+4}y^{2+1} \rightarrow$ don't forget that a '$-$' $\times$ '$-$' is a '$+$'

$= 4^{13}x^7y^3$

<u>Example 2</u>: Simplify the following and leave your answer in exponential form.

a) $\dfrac{5^8}{5^2}$ **b)** $\dfrac{12x^5y^2z^4}{3x^2y^2z^3}$ **c)** $\dfrac{3x^3y^2z^5}{18x^2yz^2}$

a) $\dfrac{5^8}{5^2} \rightarrow$ as the bases are the same, keep the base and subtract the exponents

$= 5^{8-2}$

$= 5^6$

b) $\dfrac{12x^5y^2z^4}{3x^2y^2z^3} \rightarrow$ divide coefficients as normal $\rightarrow 12 \div 3 = 4$

$= 4x^{5-2}y^{2-2}z^{4-3}$

$= 4x^3y^0z^1 \rightarrow$ anything raised to the power of 0 is equal to 1

$= 4x^3z^1$

c) $\dfrac{3x^3y^2z^5}{18x^2yz^2} \rightarrow$ divide coefficients as normal $\rightarrow \dfrac{3}{18} = \dfrac{1}{6}$

$= \dfrac{1x^{3-2}y^{2-1}z^{5-2}}{6}$

$= \dfrac{xyz^3}{6} \rightarrow$ you don't have to show the 1 on top (in the numerator)

<u>Example 3</u>: Simplify the following and leave your answer in exponential form.

a) $5p^0$ **b)** $(5p)^0$ **c)** -2^0 **d)** $(-2)^0$

a) $5p^0 \rightarrow$ only p is raised to the power of 0

$= 5 \times 1$

$= 5$

b) $(5p)^0 \rightarrow$ everything inside the bracket is raised to the power of 0

$= 1 \rightarrow$ any number raised to the power of 0

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c) $-2^0 \rightarrow$ only the 2 is raised to the power of 0, -2^0 is the same as -1×2^0

$= -1\times 1 \rightarrow 2^0 = 1$

$= -1$

d) $(-2)^0 \rightarrow$ everything inside the bracket is raised to the power of 0

$= 1$

If there are multiple bases raised to a further power, the exponent of each base is multiplied by the power.

$$\left(a^x b^y c^z\right)^q = a^{x\times q} b^{y\times q} c^{z\times q} \quad \textbf{and} \quad \left(\frac{a^x}{b^y}\right)^z = \frac{a^{x\times z}}{b^{y\times z}}$$

<u>Example 4</u>: Simplify the following and leave your answer in exponential form.

a) $\left(x^2\right)^3$ **b)** $\left(5^2 p^5\right)^3$ **c)** $\left(\frac{a^5}{b^6}\right)^3$ **d)** $\left(\frac{2x^3}{3y^2}\right)^3$

a) $\left(x^2\right)^3 \rightarrow$ multiply exponents

$= x^6$

b) $\left(5^2 p^5\right)^3 \rightarrow$ multiply exponents

$= 5^6 p^{15}$

c) $\left(\frac{a^5}{b^6}\right)^3 \rightarrow$ multiply exponents

$= \frac{a^{15}}{b^{18}}$

d) $\left(\frac{2x^3}{3y^2}\right)^3 \rightarrow$ multiply exponents

$= \frac{2^3 x^9}{3^3 y^6}$

$= \frac{8x^9}{27y^6}$

<u>Example 5</u>: Simplify $\left(2^3 x^2 + 3^1 x^2\right)^2$.

$\left(2^3 x^2 + 3^1 x^2\right)^2 \rightarrow$ do not multiply exponents over a '+' or '−' sign

$= \left(8x^2 + 3x^2\right)^2$

$= \left(11x^2\right)^2$

$= 121x^4$

Law 4 only applies to multiplication, not addition and subtraction.

Complete Exercise 1 on page 277.

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B. NEGATIVE EXPONENTS

Examine the Example below:

$$\frac{x}{x^2} = \frac{\cancel{x}}{\cancel{x} \times x} = \frac{1}{x}$$

It can be seen that $\frac{x}{x^2} = \frac{1}{x}$. However, from the laws of exponents we know that:

$$\frac{x}{x^2} = x^{1-2} = x^{-1}$$

From this we can conclude that $x^{-1} = \frac{1}{x^{+1}}$.

In other words, when a **base is raised to a negative exponent**, it means that **the base** is on the **wrong side** of the fraction line. This leads us into exponential laws 5 and 6 below.

LAW 5: A NUMERATOR RAISED TO A NEGATIVE EXPONENT

When a **base in the numerator is raised to a negative exponent,** it is equal to the **same base raised to a positive exponent** in the **denominator.**

$$a^{-x} = \frac{1}{a^{+x}}$$

LAW 6: A DENOMINATOR RAISED TO A NEGATIVE EXPONENT

When a **base in the denominator is raised to a negative exponent,** it is equal to the **same base raised to a positive exponent** in the **numerator.**

$$\frac{1}{a^{-x}} = a^{+x}$$

Example 1: Simplify the following, writing all bases with positive exponents:

a) x^{-3} **c)** $5p^{-2}$ **e)** p^7q^{-5} **g)** $\frac{3}{2x^{-4}}$

b) 2^{-4} **d)** $\frac{x^{-5}}{8}$ **f)** $\frac{1}{5^{-2}}$ **h)** $\frac{y^{-3}}{x^{-4}}$

a) x^{-3} → move the base to the denominator

$= \frac{1}{x^3}$

b) 2^{-4} → move the base to the denominator

$= \frac{1}{2^4}$

$= \frac{1}{16}$

c) $5p^{-2}$ → only the p is raised to a negative exponent

$= \frac{5^1}{p^2}$ → the 5 stays at the top as its exponent is positive

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d) $\frac{x^{-5}}{8}$ → move the base in the numerator to the denominator

$= \frac{1}{8x^5}$ → you have to write the one in the numerator

e) $p^7 q^{-5}$ → only the q is raised to a negative exponent

$= \frac{p^7}{q^5}$ → the p stays at the top as its exponent is positive

f) $\frac{1}{5^{-2}}$ → move the base to the numerator

$= 5^2$

$= 25$

g) $\frac{3}{2x^{-4}}$ → move only the base with the negative exponent to the numerator

$= \frac{3x^4}{2}$

h) $\frac{y^{-3}}{x^{-4}}$ → both bases are on the wrong side of the fraction line

$= \frac{x^4}{y^3}$

<u>Example 2</u>: Simplify $\left(x^4\right)^2 \times x^{-18} \times x^4$ and write your answer with positive exponents.

$\left(x^4\right)^2 \times x^{-18} \times x^4$ → multiply exponents

$= x^8 \times x^{-18} \times x^4$ → add the exponents

$= x^{8-18+4}$

$= x^{-6}$ → write the answer with a positive exponent

$= \frac{1}{x^6}$

<u>Example 3</u>: Simplify $5x \times (-2y)^{-2}$ and write your answer with positive exponents.

$5x \times (-2y)^{-2}$ → move the entire bracket to the denominator

$= \frac{5x}{(-2y)^2}$

$= \frac{5x}{+4y^2}$ → a negative number squared is positive

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Example 4: Simplify $\left(\frac{5}{3}\right)^{-1}$ and write your answer with positive exponents.

$$\left(\frac{5}{3}\right)^{-1}$$
$$=\frac{5^{-1}}{3^{-1}}$$
$$=\frac{3}{5}$$

> In general, when a fraction is raised to negative exponent, swap the numerators and denominators and raise them to a positive exponent.
> $$\left(\frac{x}{y}\right)^{-a}=\frac{y^a}{x^a}$$

Example 5: Simplify $\frac{a^{-1}+b^{-1}}{a+b}$ and write your answer with positive exponents.

$$\frac{a^{-1}+b^{-1}}{a+b} \rightarrow \text{split up the numerator and denominator}$$
$$=\left(a^{-1}+b^{-1}\right)\div(a+b)$$
$$=\left(\frac{1}{a}+\frac{1}{b}\right)\div(a+b) \rightarrow \text{add the fractions, LCD} = ab$$
$$=\left(\frac{a+b}{ab}\right)\div(a+b) \rightarrow \text{tip and times}$$
$$=\frac{\cancel{a+b}}{ab}\times\frac{1}{\cancel{a+b}}$$
$$=\frac{1}{ab}$$

Example 6: Simplify $\frac{18a^{-3}\left(b^4\right)^{-2}a^2}{6a^{-4}}$ and write your answer with positive exponents.

$$\frac{18a^{-3}\left(b^4\right)^{-2}a^2}{6a^{-4}} \rightarrow \text{multiply exponents, divide numbers normally}$$
$$=\frac{3a^{-3}b^{-8}a^2}{a^{-4}} \rightarrow \text{add exponents in the numerator, subtract exponents from the denominator}$$
$$=3a^{-3+2-(-4)}b^{-8}$$
$$=3a^{-3+2+4}b^{-8}$$
$$=\frac{3a^3}{b^8}$$

Complete Exercise 2 on page 277.

C. EXPONENTIAL EQUATIONS

An **exponential equation** is an equation where **the variable you are solving for is in the exponent**. When solving equations, it is important to note that if:

$$b^x = b^y \text{ then } x = y$$

This is known as **equating exponents.**
If the **bases are the same,** the **exponents are equal.**
The above rule is always true if the base is not equal to 0 or 1.

STEPS TO SOLVING EXPONENTIAL EQUATIONS

1) **Make sure the exponent with the variable is alone on one side of the equation**
2) **Use exponent laws to get the same base on both sides of the equation**
3) **Equate the exponents on either side**

Example 1: Solve for x if $2^x = 2^8$.

$2^x = 2^8 \rightarrow$ as the bases are the same on both sides of the equation, the exponents are equal

$\therefore x = 8$

Example 2: Solve for x if $3^x = 27$.

$3^x = 27 \rightarrow$ express 27 as power with base 3 to get the same bases on both sides

$\therefore 3^x = 3^3 \rightarrow 27 = 3^3$

$\therefore x = 3$

Example 3: Solve for x if $12^{x+5} = 144$.

$12^{x+5} = 144 \rightarrow$ express 144 as power with base 12 to get the same bases on both sides

$\therefore 12^{x+5} = 12^2 \rightarrow 144 = 12^2$

$\therefore x + 5 = 2 \rightarrow$ subtract 5 from both sides

$\therefore x = 2 - 5$

$\therefore x = -3$

Example 4: Solve for x if $5.7^x = 245$.

$5.7^x = 245 \rightarrow$ divide both sides by 5, the . represents multiply

$\therefore 7^x = 49 \rightarrow 245 \div 5 = 49$

$\therefore 7^x = 7^2 \rightarrow 49 = 7^2$

$\therefore x = 2$

Example 5: Solve for x if $5^x = \frac{1}{25}$.

$5^x = \frac{1}{25} \rightarrow$ express 25 as power with base 5 to get the same bases on both sides

$\therefore 5^x = \frac{1}{5^2} \rightarrow$ bring the 5 to the top by making the exponent negative

$\therefore 5^x = 5^{-2}$

$\therefore x = -2$

Example 6: Solve for x if $31^x = 1$.

$31^x = 1 \rightarrow$ any number raised to the power of 0 equals 1

$\therefore 31^x = 31^0 \rightarrow 31^0 = 1$

$\therefore x = 0$

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<u>Example 7</u>: Determine the value of x if $3^x = \frac{1}{9}$:

$3^x = \frac{1}{9} \rightarrow$ convert 9 into base 3 using the laws of exponents

$\therefore 3^x = \frac{1}{3^2} \rightarrow$ 'bring the base to the top' using the fact that $a^{-x} = \frac{1}{a^x}$

$\therefore 3^x = 3^{-2} \rightarrow$ once bases are the same you can equate the exponents

$\therefore x = -2$

<u>Example 8</u>: Determine the value of x if $3\left(2^x\right) = 24$:

$3\left(2^x\right) = 24 \rightarrow$ divide both sides by 3

$\therefore \frac{\cancel{3}\left(2^x\right)}{\cancel{3}} = \frac{24}{3}$

$\therefore 2^x = 8 \rightarrow$ convert 8 into base 2 using the laws of exponents

$\therefore 2^x = 2^3 \rightarrow$ now equate exponents

$\therefore x = 3$

<u>Example 9</u>: Determine the value of x if $7^x\left(7^{x+2}\right) = 49$:

$7^x\left(7^{x+2}\right) = 49 \rightarrow$ use laws of exponents

$\therefore 7^{x+x+2} = 49 \rightarrow$ convert 49 into base 7 using the laws of exponents

$\therefore 7^{2x+2} = 7^2 \rightarrow$ now equate exponents

$\therefore 2x + 2 = 2 \rightarrow$ take the 2 over to the RHS

$\therefore 2x = 0 \rightarrow$ divide both sides by 2

$\therefore \frac{\cancel{2}x}{\cancel{2}} = \frac{0}{2}$

$\therefore x = 0$

Example 8 and 9 above rely on your knowledge and ability to work with equations from Grade 8. If needed, revise equations on page 93.

You can only equate exponents if the bases are the same.

Complete Exercise 3 on page 278.

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D. SCIENTIFIC NOTATION

Scientific notation is used to write very large or very small numbers in a convenient form that is easy to work with.

Scientific notation is always written as a decimal with one digit to the left of the comma and then multiplied by a power of 10. It is always written in the form of:

$$a,b\ldots\times 10^n$$

Where a is a number from 1 to 9 (including 9).

Important notes on multiplication:

- **When multiplying a number by 10 the decimal comma moves one place to the right.**
- **When multiplying a number by 100 (10^2) the decimal comma moves two places to the right.**
- **When multiplying a number by 10^n the decimal comma moves n places to the right.**

Important notes on division:

- **When dividing a number by 10 the decimal comma moves one place to the left. Dividing by 10 is the same as multiplying by 10^{-1}.**
- **When dividing a number by 100 the decimal comma moves two places to the left. Dividing by 100 is the same as multiplying by 10^{-2}.**
- **When dividing a number by 10^n the decimal comma moves n places to the left. Dividing by 10^n is the same as multiplying by 10^{-n}.**

<u>Illustrative Example 1</u>: The number $3{,}22 \times 10^4$ is written in scientific notation. Write this number in expanded form.

$3{,}22\times 10^4 \rightarrow$ move the decimal comma 4 places to the right

$= 32\,200 \rightarrow$ fill missing places with 0's

$= 32\,200$

<u>Illustrative Example 2</u>: The number $3{,}22 \times 10^{-4}$ is written in scientific notation. Write this number in expanded form.

$3{,}22\times 10^{-4} \rightarrow$ move the decimal comma 4 places to the left

$= 0{,}000322 \rightarrow$ fill missing places with 0's, if there's no number before the comma the number is a 0

$= 0{,}000322$

STEPS TO WRITING SCIENTIFIC NOTATION IN EXPANDED FORM

1) **Examine the power $\times 10^n$.**
   a) **If n is positive, move the decimal comma n places to the right.**
   b) **If n is negative, move the decimal comma n places to the left.**
2) **Fill any missing places with zeros.**

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Example 1: Write 2,302 × 10² in expanded form.

$2,302 \times 10^{2}$ → move the decimal comma 2 places to the right

$= 230,2$

$= 230,2$

Example 2: Write 2,302 × 10⁻² in expanded form.

$2,302 \times 10^{-2}$ → move the decimal comma 2 places to the left

$= 0,02302$ → fill missing places with 0's, if there's no number before the comma the number is a 0

$= 0,02302$

Complete Exercise 4 number 1 on page 278.

STEPS TO WRITING LARGE NUMBERS IN SCIENTIFIC NOTATION

1) **If there is no comma present, place a comma behind the last digit.**
2) **Move the comma to the left so that there is 1 digit to the left of the comma**
3) **Count the number of digits to the right of the comma and write the number in the form *a*,b… × 10*ⁿ* where *n* is the number of times you moved the comma.**
4) **Drop any zeros after the comma**

The above steps can be used for any number greater than 1 or less than –1.

Example 1: Write the number 5 133 000 000 in scientific notation.

$5133000000,$ → move the comma 9 places to the left

$= 5,133 \times 10^{9}$ → the comma moved back 9 places and zeros after the comma were dropped

Example 2: Write the number 3 202 000 000 000 000 000 in scientific notation.

$3202000000000000000,$ → move the comma 18 places to the left

$= 3,202 \times 10^{18}$ → the comma moved left 18 places and zeros after the comma were dropped

STEPS TO WRITING SMALL NUMBERS IN SCIENTIFIC NOTATION

1) **Move the comma to the right so that there is 1 digit to the left of the comma**
2) **Write the number in the form *a*,b… × 10⁻*ⁿ* where *n* is the number of times you moved the comma to the right.**
3) **Drop any zeros before the comma**

The above steps can be used for any numbers between –1 and 1.

Example 1: Write the number 0,0000006523 in scientific notation.

$0,0000006523$ → move the comma 7 places to the right

$= 6,523 \times 10^{-7}$ → the comma moved right 7 places and zeros before the comma were dropped

Example 2: Write the number 0,00000000000017 in scientific notation.

$0,00000000000017$ → move the comma 13 places to the right

$= 1,7 \times 10^{-13}$ → the comma moved right 13 places and zeros before the comma were dropped

Complete Exercise 4 number 2 on page 278.

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MOVING THE DECIMAL PLACE IN SCIENTIFIC NOTATION

From the above examples we can formulate the rules shown below for moving a decimal place in scientific notation:

$\longleftarrow 10^n$

When moving the decimal place to the **left n gets larger**

$10^n \longrightarrow$

When moving the decimal place to the **right n gets smaller**

Example 1: Write 156×10^4 in scientific notation.

It is important to note that the decimal place in 156×10^4 is after the 6. In other words, 156×10^4 can be written as $156, \times 10^4$. In order to write this number in scientific notation the decimal place has to be moved two places to the left.

$156 \times 10^4 \rightarrow$ the comma needs to be moved 2 places to the left

$= 1,56 \times 10^{4+2} \rightarrow$ the exponent increases by 2 as the comma moved 2 places left

$= 1,56 \times 10^6$

Example 2: Write $0,00156 \times 10^{-5}$ in scientific notation.

$0,00156 \times 10^{-5} \rightarrow$ the comma needs to be moved 3 places to the right

$= 1,56 \times 10^{-5-3} \rightarrow$ the exponent decreases by 3 as the comma moves 3 places right

$= 1,56 \times 10^{-8}$

Example 3: Write $1504,1 \times 10^{-5}$ in scientific notation.

$1504,1 \times 10^{-5} \rightarrow$ the comma needs to be moved 3 places to the left

$= 1,5041 \times 10^{-5+3} \rightarrow$ the exponent increases by 3 as the comma moves 3 places left

$= 1,5041 \times 10^{-2}$

Example 4: Write -12×10^2 in scientific notation.

$-12 \times 10^2 \rightarrow$ the comma needs to be moved 1 place to the left

$= -1,2 \times 10^{2+1} \rightarrow$ the exponent increases by 1 as the comma moves 1 place left

$= -1,2 \times 10^3$

Example 5: Write 1205×10^7 in scientific notation.

$1205 \times 10^7 \rightarrow$ the comma needs to be moved 3 places to the left

$= 1,205 \times 10^{7+3} \rightarrow$ the exponent increases by 3 as the comma moves 3 places left

$= 1,205 \times 10^{10}$

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MULTIPLICATION AND DIVISION OF NUMBERS IN SCIENTIFIC NOTATION

When dealing with multiplication and division of numbers in scientific notation you make use of the law 1 and 2 of exponents (pg. 42)

Example 1: Calculate the value of $(3{,}5\times 10^4)\times(2\times 10^8)$ and write your answer in scientific notation.

$(3{,}5\times 10^4)\times(2\times 10^8) \rightarrow$ multiply numbers normally and multiply the bases of 10 together

$= 7\times 10^{4+8} \rightarrow 3{,}5\times 2 = 7,$ law 1 of exponents $10^4\times 10^8 = 10^{4+8}$

$= 7\times 10^{12}$

Example 2: Calculate the value of $(-5\times 10^{-3})\times(3\times 10^7)$ and write your answer in scientific notation.

$(-5\times 10^{-3})\times(3\times 10^7) \rightarrow$ multiply numbers normally and multiply the bases of 10 together

$= -15\times 10^{-3+7} \rightarrow -5\times 3 = -15,$ law 1 of exponents $10^{-3}\times 10^7 = 10^{-3+7}$

$= -15\times 10^4 \rightarrow$ you now have to write this in scientific notation

$= -1{,}5\times 10^{4+1} \rightarrow$ 1 is added to the exponent as the comma moved 1 place left

$= -1{,}5\times 10^5$

Example 3: Calculate the value of $\dfrac{8\times 10^5}{2\times 10^2}$ and write your answer in scientific notation.

$\dfrac{8\times 10^5}{2\times 10^2} \rightarrow$ divide numbers normally and multiply the bases of 10 together

$= 4\times 10^{5-2} \rightarrow 8\div 2 = 4,$ law 2 of exponents $10^5\div 10^2 = 10^{5-2}$

$= 4\times 10^3$

Example 4: Calculate the value of $\dfrac{100\times 10^3}{4\times 10^{12}}$ and write your answer in scientific notation.

$\dfrac{100\times 10^3}{4\times 10^{12}} \rightarrow$ divide numbers normally and multiply the bases of 10 together

$= 25\times 10^{3-12} \rightarrow 100\div 4 = 25,$ law 2 of exponents $10^3\div 10^{12} = 10^{3-12}$

$= 25\times 10^{-9} \rightarrow$ you now have to write this in scientific notation

$= 2{,}5\times 10^{-9+1} \rightarrow$ 1 is added to the exponent as the comma moved 1 place left

$= 2{,}5\times 10^{-8}$

Complete Exercise 5 number 1 on page 278.

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ADDITION AND SUBTRACTION OF NUMBERS IN SCIENTIFIC NOTATION

When **adding or subtracting numbers** written in **scientific notation**, the **exponents of the base 10 have to be the same**.

Example 1: Calculate the value of $1{,}2 \times 10^2 + 1{,}3 \times 10^4$.

$1{,}2 \times 10^2 + 1{,}3 \times 10^4 \rightarrow$ make both exponents 4 by moving the decimal 2 places left

$= 0{,}012 \times 10^4 + 1{,}3 \times 10^4 \rightarrow$ add the decimals together and ignore the bases of 10

$= 1{,}312 \times 10^4 \rightarrow$ add back the base of 10

Example 2: Calculate the value of $3{,}4 \times 10^{-4} + 0{,}3 \times 10^{-5}$.

$3{,}4 \times 10^{-4} + 0{,}3 \times 10^{-5} \rightarrow$ make both exponents -4 by moving the decimal 1 place left

$= 3{,}4 \times 10^{-4} + 0{,}03 \times 10^{-4} \rightarrow$ add the decimals together and ignore the bases of 10

$= 3{,}43 \times 10^{-4} \rightarrow$ add back the base of 10

Example 3: Calculate the value of $5{,}56 \times 10^{-8} - 3{,}3 \times 10^{-9}$.

$5{,}56 \times 10^{-8} - 3{,}3 \times 10^{-9} \rightarrow$ make both exponents -8 by moving the decimal 1 place left

$= 5{,}56 \times 10^{-8} - 0{,}33 \times 10^{-8} \rightarrow$ add the decimals together and ignore the bases of 10

$= 5{,}23 \times 10^{-8} \rightarrow$ add back the base of 10

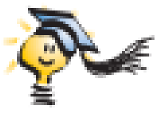
Example 4: Calculate the value of $-2 \times 10^{10} - 4 \times 10^9$ and write your answer in scientific notation.

$-2 \times 10^{10} - 4 \times 10^9 \rightarrow$ make both exponents 9 by moving the decimal 1 place right

$= -20 \times 10^9 - 4 \times 10^9 \rightarrow$ add the decimals together and ignore the bases of 10

$= -24 \times 10^9 \rightarrow$ add back the base of 10

$= -2{,}4 \times 10^{10} \rightarrow$ write your answer in scientific notation



Complete Exercise 5 number 2 on page 279 and the Mixed Exercise on page 279.

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LIFE ORIENTATION

REVISION BOOKLET

TERM 2

2024

GRADE 12

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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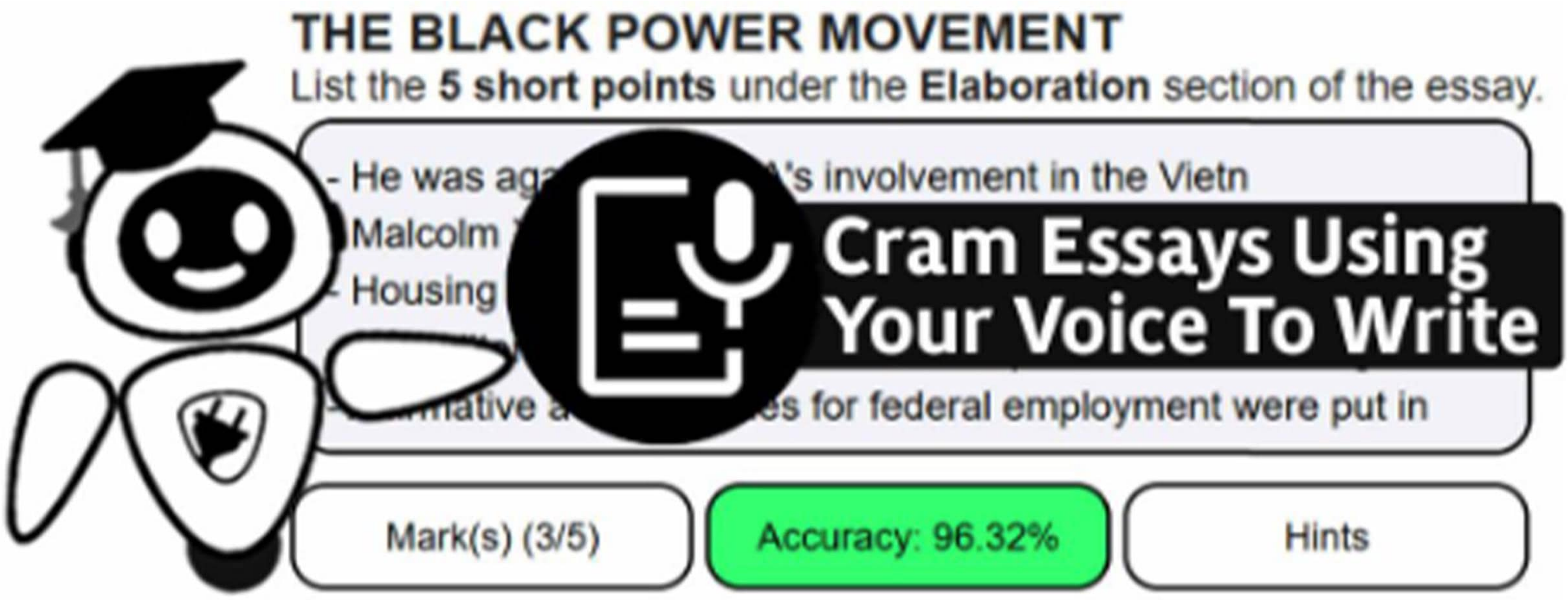

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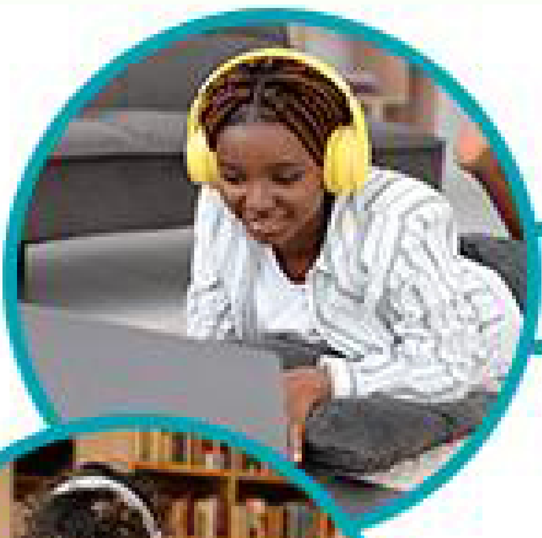

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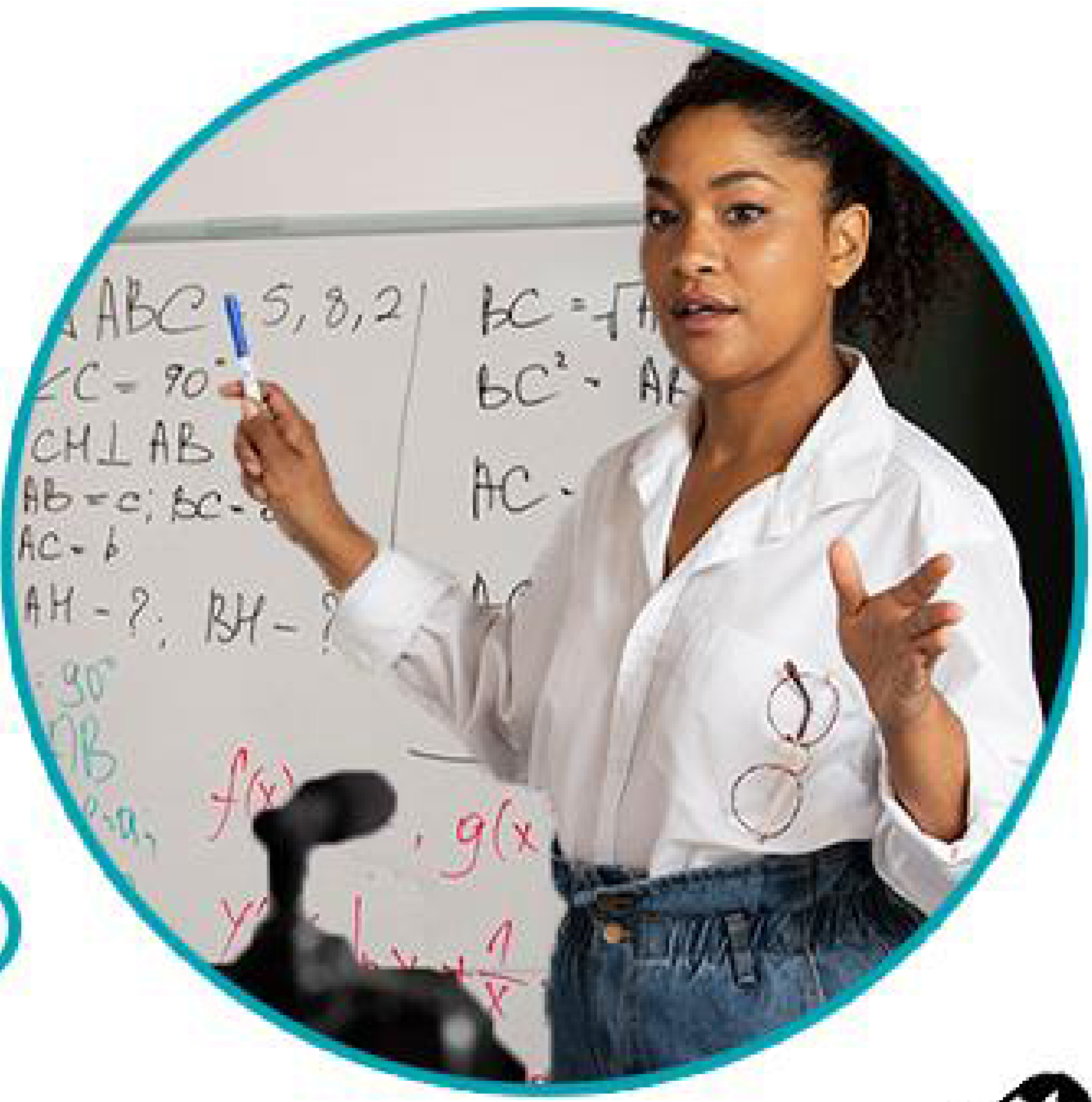

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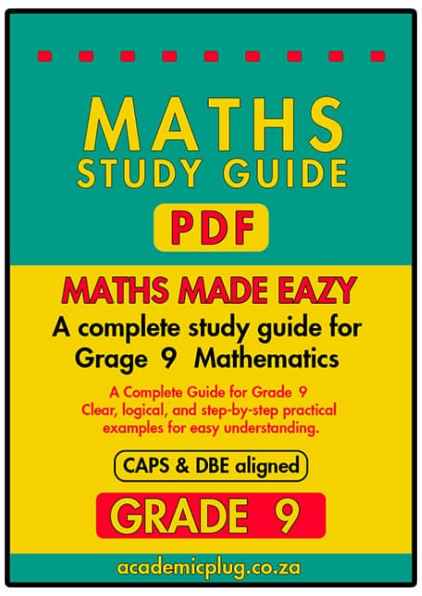

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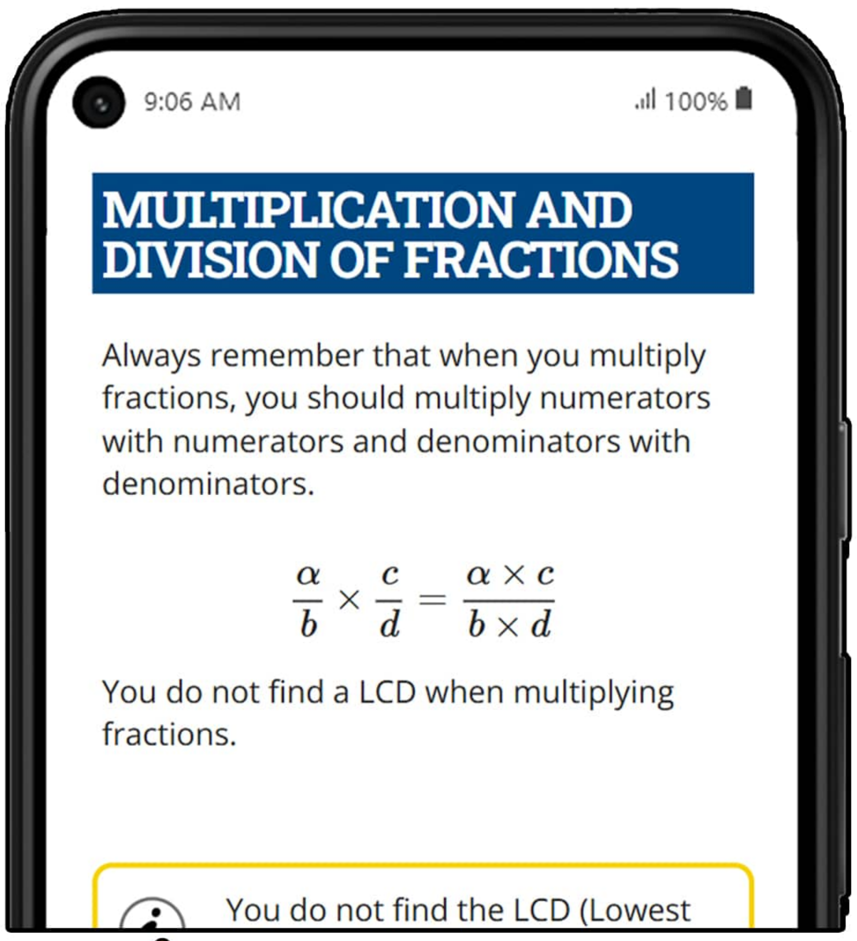

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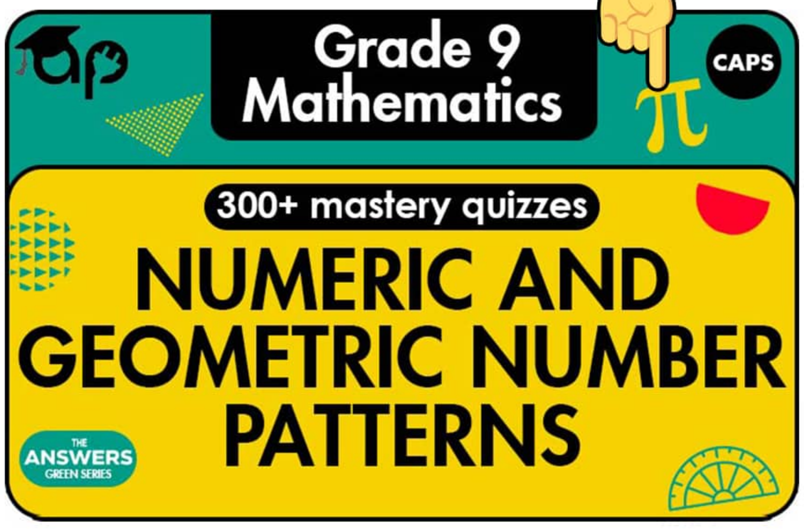

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CHAPTER 6
NUMERIC AND GEOMETRIC NUMBER PATTERNS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
56	**A. Numeric Number Patterns**	2.1	• Investigate and extend numeric and geometric patterns looking for relationships between numbers including patterns represented in physical or diagram form • Describe and justify the general rules for observed relationships between numbers in your own words or in terms of an algebraic equation
56	• Revision of Terminology and Notation		
57	• Number Patterns with a Constant Difference		
57	• Steps to Writing a General Rule for Patterns with a Constant Difference		
58	• Number Patterns with a Constant Ratio		
59	• Patterns without a Constant Difference or Ratio		
61	**B. Geometric Number Patterns**		

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A. NUMERIC NUMBER PATTERNS

In Grade 8 you learnt that a **numeric number pattern** is a sequence of numbers that follow a specific pattern.
An example of a numeric pattern is one where there is a **constant difference between consecutive terms**. In other words, the same number would be added to, or subtracted from each consecutive term.

REVISION OF TERMINOLOGY AND NOTATION

Examine the number pattern: 5 ; 8 ; 11 ; 14 ; …

- **Another name for a pattern is a sequence**
- **Each number in the sequence is called a term**
- **The sequence can be described in words as follows:**
  The 1st term is 5. Add 3 to the 1st term to obtain the 2nd term which is 8. Continue adding 3 to each term to obtain the next term.

The notation usually used in sequences is $\mathbf{T_1 = 5}$; $\mathbf{T_2 = 8}$; $\mathbf{T_3 = 11}$; $\mathbf{T_4 = 14}$

It is important to understand that when using this notation, the numbers in **red are the position of the term in the sequence**. The numbers in **green are the values of that term**.

The position of the term in the sequence ← $T_{①} = ⑤$ → The value of the term in the stated position
In this case the term is in position 1 — In this case the value of the term in position 1 is 5

<u>Example 1</u>: **Examine the sequence 10 ; 7 ; 4 ; 1 ; …**

a) Copy the pattern down and write down the next three terms in the pattern.
b) Write down the value T_4.
c) Which term is equal to –5?
d) Write down the value of n if $T_n = -2$.

a) 10 ; 7 ; 4 ; 1 ; –2 ; –5 ; –8 → 3 is being subtracted from the previous term
b) $T_4 = 1$ → 1 is the term in the 4th position
c) The 6th term → $T_6 = -5$
d) $n = 5 \rightarrow T_5 = -2$

<u>Example 2</u>: **Given that any term in a number pattern is: $T_n = 2 \times n + 1$:**

a) Determine the value of the 1st term.
b) Determine the value of the 95th term.
c) Write down a rule for this pattern in words.

a) $T_n = 2 \times n + 1 \rightarrow$ the 1st term is when $n = 1$
$\therefore T_1 = 2(1) + 1 \rightarrow$ replace every n with 1
$= 3$

b) $T_n = 2 \times n + 1 \rightarrow$ the 95th term is when $n = 95$
$\therefore T_{95} = 2(95) + 1 \rightarrow$ replace every n with 95
$= 191$

c) To obtain any term in the sequence multiply the term number by 2 and then add 1.

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NUMBER PATTERNS WITH A CONSTANT DIFFERENCE

Examine the sequence: 2 ; 5 ; 8 ; 11 ; …

It can easily be seen that the difference between each term in the above sequence is 3.

2 ; 5 ; 8 ; 11

3 3 3

For sequences with a constant difference, there is a general rule (formula) that can be used to determine any term in the sequence. This is shown in the green block below.

General mathematical rule for a sequence with a constant difference:

$$T_n = d(n) + c$$

Where: $n \rightarrow$ **Term number**
$d \rightarrow$ **Constant difference between terms**
$c \rightarrow$ **The number that has to be added to each term**

STEPS TO WRITING A GENERAL RULE FOR PATTERNS WITH A CONSTANT DIFFERENCE

1) **Determine the constant difference between consecutive terms.**
2) **Determine the value of c. The value of c is the number that has to be added/subtracted to/from d to obtain the first term.**

Example: Given the pattern –5 ; –2 ; 1 ; 4 ; …

a) **Determine a general mathematical rule to determine any term in the above pattern.**
b) **Use your rule to determine the 60th term in the pattern.**
c) **Which term in the pattern will be equal to 55?**

a) Step 1: The constant difference between each term is 3.
$\therefore T_n = 3n + c$
Step 2:
The first term is –5. Determine the value of c, the number which has to be added to 3 (the constant difference) to obtain –5 (the first term).
$\therefore c = -5 - 3$
$= -8$
$\therefore T_n = 3n - 8$

b) You are looking for the 60th term. Therefore, $n = 60$.
$\therefore T_{60} = 3(60) - 8$
$= 180 - 8 \rightarrow 3 \times 60 = 180$
$= 172$
$\therefore$ The 60th term is equal to 172.

c) $T_n = 63$
$55 = 3n - 8 \rightarrow$ add 8 to both sides
$\therefore 63 = 3n \rightarrow$ divide both sides by 3
$\therefore 21 = n$
$\therefore T_{21} = 55$
$\therefore$ the 21st term of the pattern is equal to 55

Complete Exercise 1 on page 286.

NUMBER PATTERNS WITH A CONSTANT RATIO

Examine the sequence: 5 ; 10 ; 20 ; 40 ; 80 ; …

Term 1	Term 2	Term 3	Term 4	Term 5	Term n
$5=5(2)^0$	$10=5(2)^1$	$20=5(2)^2$	$40=5(2)^3$	$80=5(2)^4$	$5(2)^{n-1}$

$$\frac{T_2}{T_1}=\frac{10}{5}=2 \text{ and } \frac{T_3}{T_2}=\frac{20}{10}=2 \text{ and } \frac{T_4}{T_3}=\frac{40}{20}=2 \text{ and } \frac{T_5}{T_4}=\frac{80}{40}=2$$

For the above sequence it can be seen that there is a constant ratio of 2 between consecutive terms. In this pattern the sequence is created by **multiplying each term by** r, which in the above sequence is equal to 2. From the above table the general rule for any term in the sequence is: **multiply the first term by the constant ratio raised to the power of 1 less than the term number.**

General mathematical rule for a sequence with a constant ratio:

$$T_n = ar^{n-1}$$

Where: $n \to$ **Term number**
$r \to$ **Constant ratio between terms**
$a \to$ **The first term**

STEPS TO WRITING A GENERAL RULE FOR PATTERNS WITH A CONSTANT DIFFERENCE

1) **Determine the constant ratio between consecutive terms.**
2) **Substitute the first term of the sequence into a.**

Example: Given the pattern below:

Term number (n)	1	2	3	4
Term (T_n)	6	12	24	48

a) **What is the constant ratio for the pattern?**
b) **Determine a general mathematical rule to determine any term in the above pattern.**
c) **Determine the 6th term of the pattern.**
d) **Determine the 50th term of the pattern. Leave your answer in the form $T_n = ar^n$.**

a) $2 \to \frac{12}{6}=2$ and $\frac{24}{12}=2$ and $\frac{48}{24}=2$

b) $T_n = ar^n$

$T_n = 6(2)^{n-1} \to a=6$ and $r=2$

c) $T_6 = 6(2)^{6-1} \to$ substitute $n=6$

$=6(32)$

$=192$

d) $T_{50} = 6(2)^{50-1} \to$ substitute $n=50$

$=6(2)^{49}$

Complete Exercise 2 on page 286.

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PATTERNS WITHOUT A CONSTANT DIFFERENCE OR RATIO

Example 1: Examine the pattern in the table below:

Position (n)	1	2	3	4	5
Term	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{1}{8}$	$\frac{1}{11}$	$\frac{1}{14}$

a) What is the value of the 6th and 7th term?
b) Determine a general mathematical rule to determine any term in the above pattern.
c) Use your rule to determine the 100th term of the pattern.

a) Although there is not a constant difference between terms, there is a constant difference of **3** between the denominators.

$$\therefore T_6 = \frac{1}{17} \text{ and } T_{78} = \frac{1}{20}$$

b) First calculate a general formula for the denominators of the fractions:

$\therefore T_n = 3n + c \rightarrow$ the constant difference of the denominator is 3

The first term in the denominator is **2**. Determine the value of ***c***, the number which has to be added to **3** (the constant difference) to obtain **2** (the first term).

$$\therefore c = 2 - 3$$
$$= -1$$

$\therefore \mathrm{T}_n = 3n - 1 \rightarrow$ this is the general formula for the denominator

$\therefore$ The general formula for the sequence is:

$$\mathrm{T}_n = \frac{1}{3n-1}$$

c) $$\mathrm{T}_{100} = \frac{1}{3(100)-1}$$
$$= \frac{1}{299}$$

Example 2: Examine the pattern in the table below:

Position (n)	1	2	3	4	5	6	7
Term	1	4	9	16	25	36	49

a) What is the value of the 10th term?
b) Describe a rule in words to determine value of any term (nth term) in the sequence.
c) Write down a mathematical rule to determine the value of any term in the sequence.
d) Use your rule to determine the 100th term of the pattern

a) $\mathrm{T}_{10} = 100$

b) The value of any term in the sequence is equal to the term's position in the sequence **squared**.

c) $\mathrm{T}_n = n^2$

d) $$\mathrm{T}_{100} = 100^2$$
$$= 10\,000$$

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Example 3: **Examine the pattern below:**

Position (n)	**1**	**2**	**3**	**4**	**5**
Term	$\dfrac{1}{2\times 3}$	$\dfrac{2}{3\times 4}$	$\dfrac{3}{4\times 5}$	$\dfrac{4}{5\times 6}$	$\dfrac{5}{6\times 7}$

a) What is the value of the 6th term?

b) Write down a mathematical rule to determine the value of any term in the sequence.

c) Use your rule to determine the 100th term of the pattern. You do not have to simplify your answer.

a) $T_1 = \dfrac{1}{2\times 3} \rightarrow \dfrac{1}{(1+1)\times(1+2)}$

$T_2 = \dfrac{2}{3\times 4} \rightarrow \dfrac{2}{(2+1)\times(2+2)}$

$T_3 = \dfrac{3}{4\times 5} \rightarrow \dfrac{3}{(3+1)\times(3+2)}$

$T_4 = \dfrac{4}{5\times 6} \rightarrow \dfrac{4}{(4+1)\times(4+2)}$

$T_5 = \dfrac{5}{6\times 7} \rightarrow \dfrac{5}{(5+1)\times(5+2)}$

It can be seen that the numerator (**top of the fraction**) is always **equal to the position of the term (n)** in the pattern.
The denominator (bottom of the fraction) is equal to **1 more than the numerator multiplied by 2 more than the numerator.**

$$\therefore T_6 = \frac{6}{(6+1)\times(6+2)} = \frac{6}{7\times 8} = \frac{6}{56} = \frac{3}{28}$$

b) $T_n = \dfrac{n}{(n+1)\times(n+2)}$

c) $T_{100} = \dfrac{100}{(100+1)\times(100+2)} = \dfrac{100}{101\times 102}$

Complete Exercise 3 on pages 286 and 287

B. GEOMETRIC NUMBER PATTERNS

A **geometric number pattern** is a pattern formed with **shapes or diagrams**.
You have dealt with these types of patterns previously in Grade 7 and Grade 8.

<u>Example 1</u>: Consider the pattern of smiling faces below:

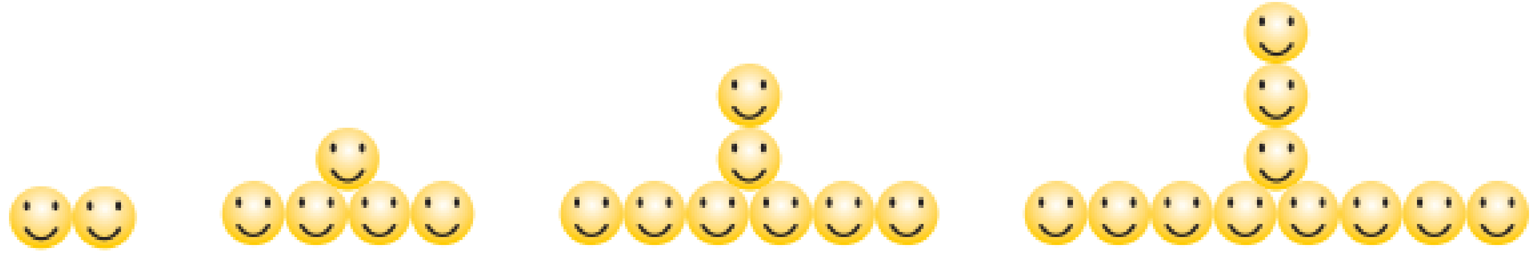

Figure 1 Figure 2 Figure 3 Figure 4

a) Draw the next two figures in the pattern.
b) How many faces are added in each pattern?
c) Write down a general mathematical rule to determine the number of faces in any pattern.
d) Use your general rule to determine the number of faces in the 20th pattern.
e) Which figure will contain 119 faces?

a)

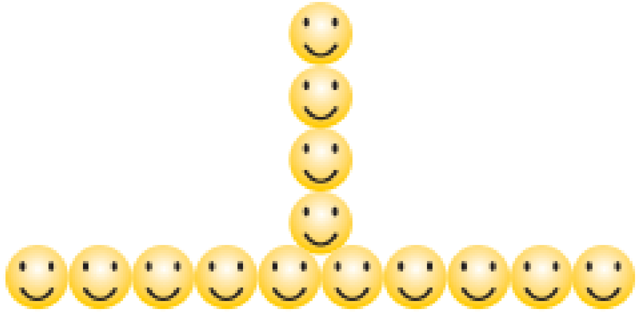

Figure 5

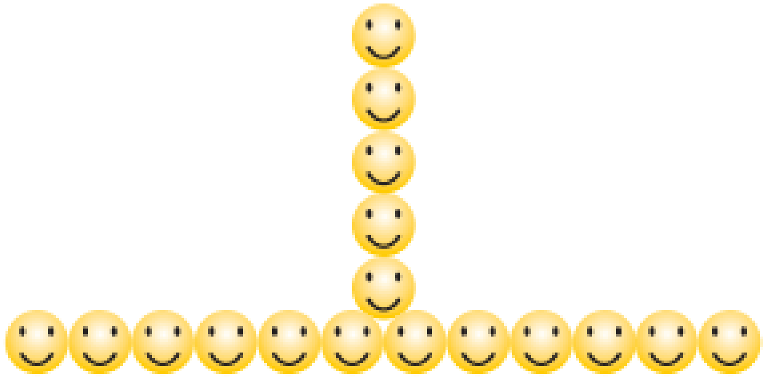

Figure 6

b) **3**

c) Step 1: The constant difference between each term is **3**.

$\therefore T_n = \mathbf{3}(n) + c$

Step 2:
The first term is **2**. Determine the value of ***c***, the number which has to be added to **3** (the constant difference) to obtain 2 (the first term).

$\therefore c = 2 - 3$

$= -1$

$\therefore T_n = 3(n) - 1$

d) $T_{20} = 3(20) - 1$

$= 59$ faces

e) $T_n = 119$

$119 = 3n - 1 \rightarrow$ add 1 to both sides

$\therefore 120 = 3n \rightarrow$ divide both sides by 3

$\therefore 40 = n$

$\therefore T_{40} = 119$

$\therefore$ The 40th term of the pattern is equal to 119.

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Example 2: **The figures below show the layout of tables in a restaurant. A single table can seat 4 people. If there are more than 4 people that require a table, the restaurant pushes tables together to accommodate more people.**

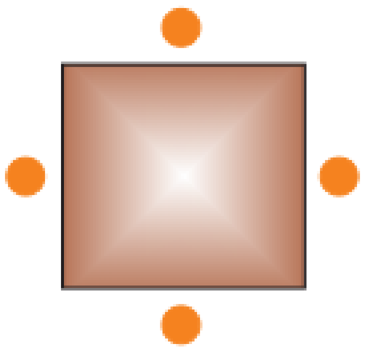

Figure 1

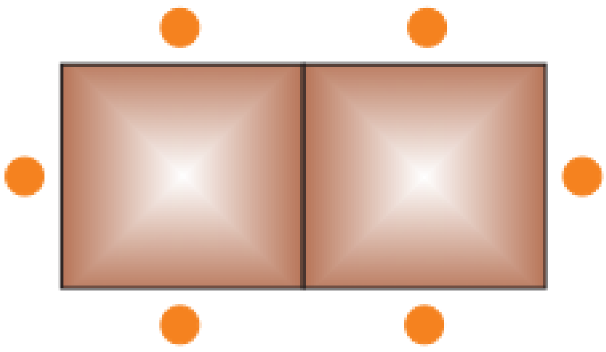

Figure 2

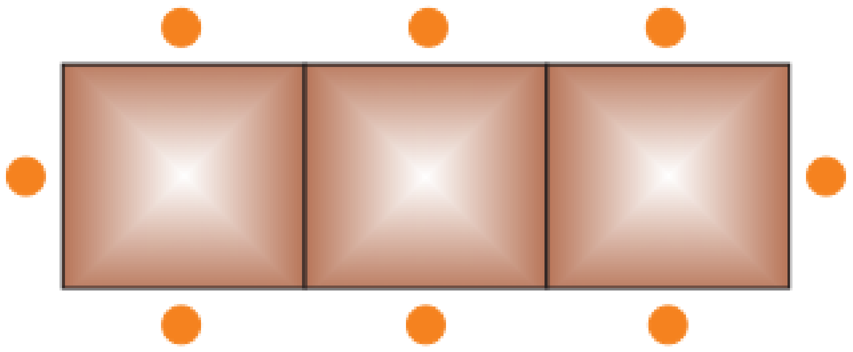

Figure 3

a) Complete the table below:

Figure (n)	**1**	**2**	**3**	**4**	**5**	**6**
Number of tables	1	2	3			
Number of seats	4	6	8			

b) Write down a general mathematical rule to determine the number of seats in any figure.

c) The restaurant is hosting an event which requires enough seating for 350 people. The restaurant will push groups of 8 tables together for the guests. What is the minimum number of tables that will be required to seat the 350 guests in this arrangement?

a)

Figure (n)	**1**	**2**	**3**	**4**	**5**	**6**
Number of tables	1	2	3	4	5	6
Number of seats	4	6	8	10	12	14

b) Step 1: The constant difference between each term is **2**.

$\therefore T_n = 2(n) + c$

Step 2:

The first term is **4**. Determine the value of c, the number which has to be added to **2** (the constant difference) to obtain 2 (the first term).

$\therefore c = 4 - 2$

$= 2$

$\therefore T_n = 2(n) + 2$

c) $T_8 = 2(8) + 2$

$= 18$ people per 8 table grouping

$350 \div 18$

$= 19,44 \rightarrow$ this means there will be 19 groups of 8 tables

19 groups of 8 tables can seat 342 people $\rightarrow 19 \times 18$

This leaves 8 people which still need to be seated. It can be seen above that 3 tables are required to seat 8 people.

$\therefore$ Total number of tables $= (19 \times 8) + 3$

$= 155$ tables

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<u>Example 3</u>: The cubes shown below are each made up of smaller cubes.

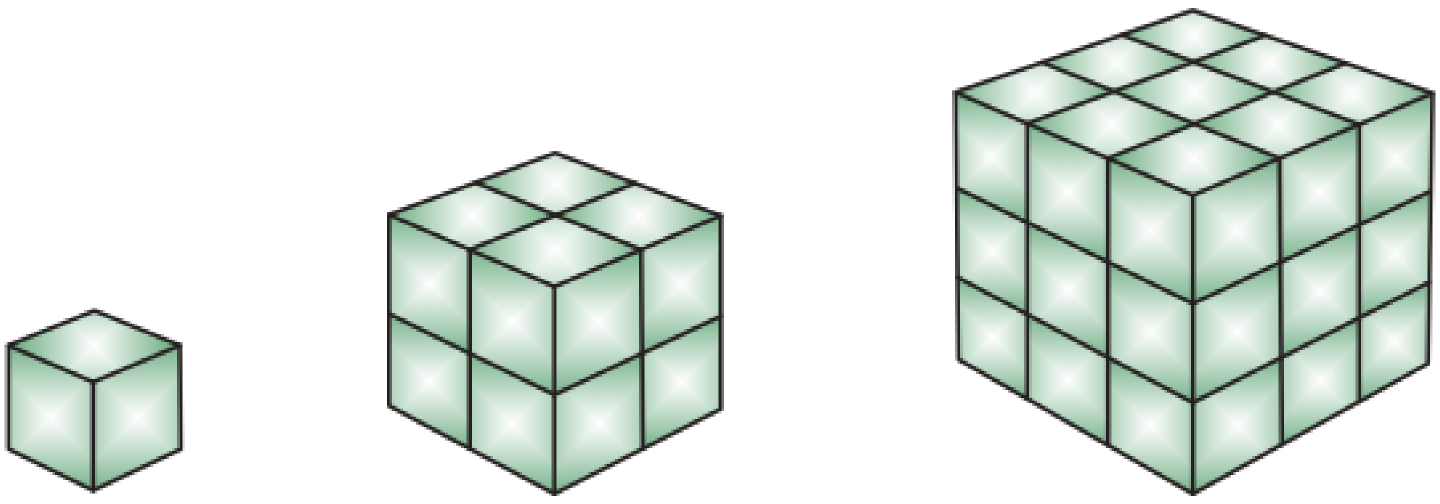

Figure 1 Figure 2 Figure 3

a) How many smaller cubes will the next figure have?
b) Write down a general mathematical rule to determine the number of smaller cubes in any figure.
c) Use your general rule to determine the number of smaller cubes in the 11th figure.
d) If Janine has 168 smaller cubes which figure in the pattern could she build?

a) Figure 1 has 1 cube $\rightarrow 1^3$

Figure 2 has 8 cubes $\rightarrow 8 = 2^3$

Figure 3 has 27 cubes $\rightarrow 27 = 3^3$

$\therefore$ Figure 4 has 64 cubes $\rightarrow 64 = 4^3$

b) The number of smaller cubes is equal to the figure number **cubed**.

$T_n = n^3$

c) $T_{11} = (11)^3$

$= 1331$

d) $T_n = 168$

$168 = n^3 \rightarrow$ cube root both sides

$\therefore \sqrt[3]{168} = \sqrt[3]{n^3}$

$\therefore n = 5,52$

$\therefore$ There are enough cubes to build the 5th figure.

The Mixed Exercise on page 287.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal.
B. improve employment opportunities of disadvantaged people, opportunities for all.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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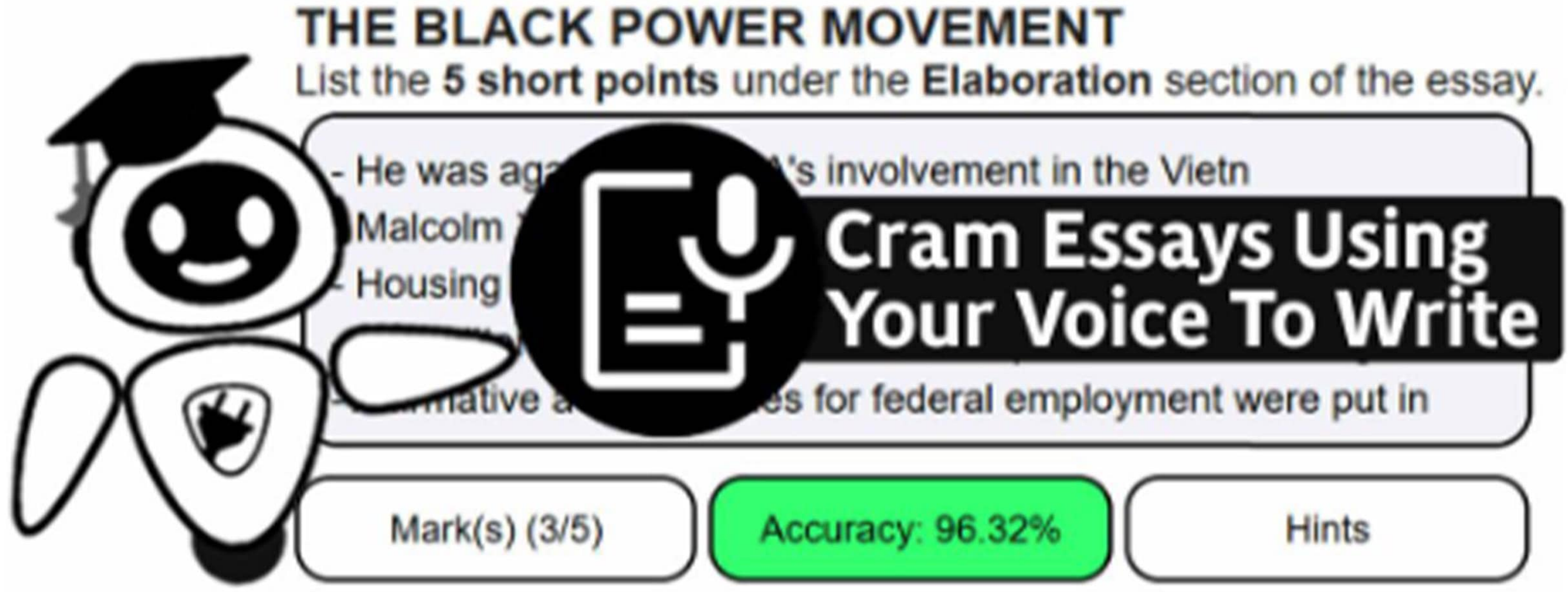

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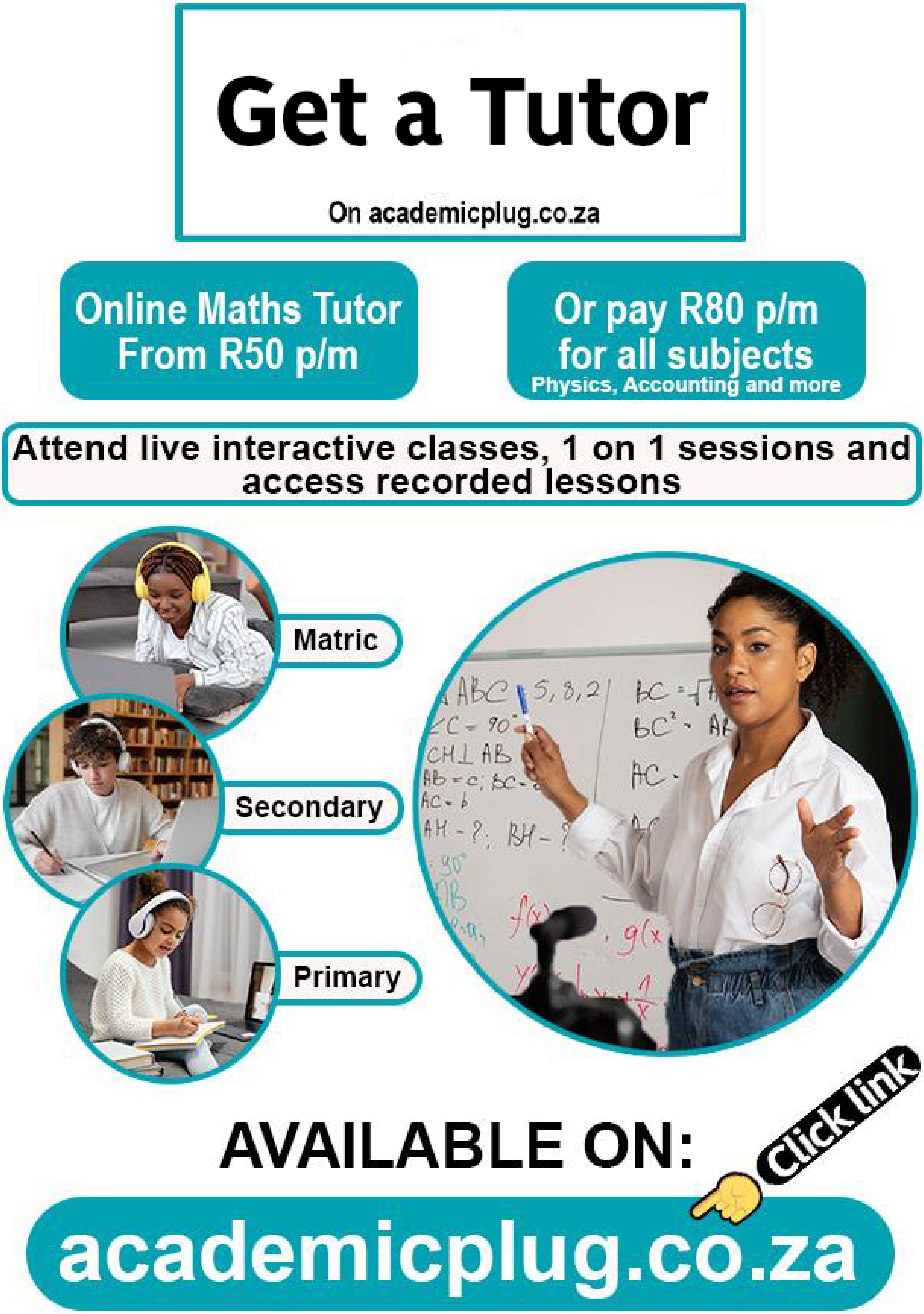
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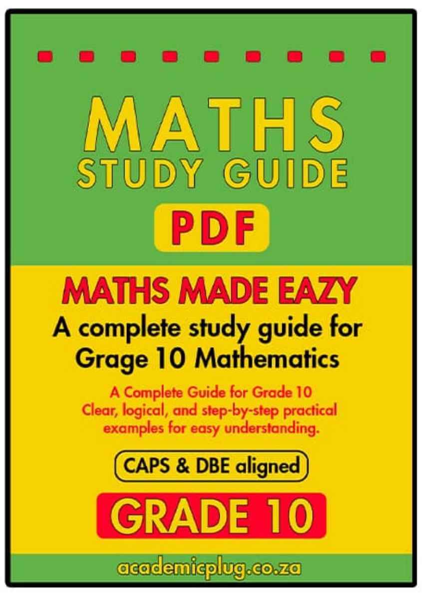

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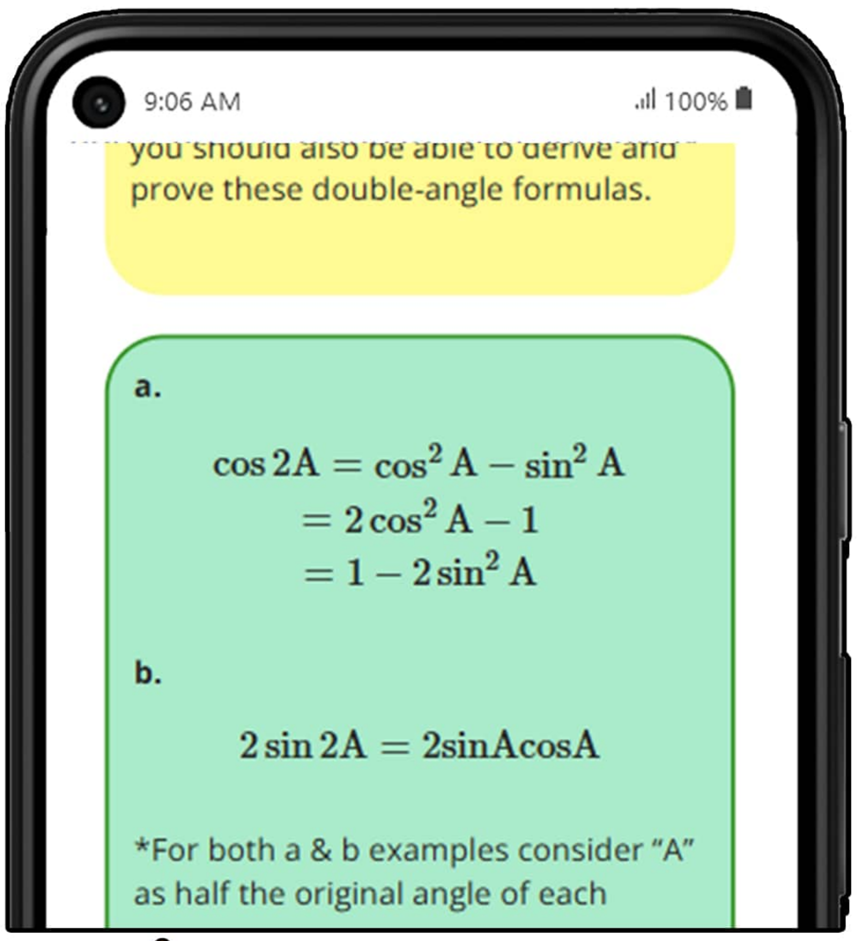

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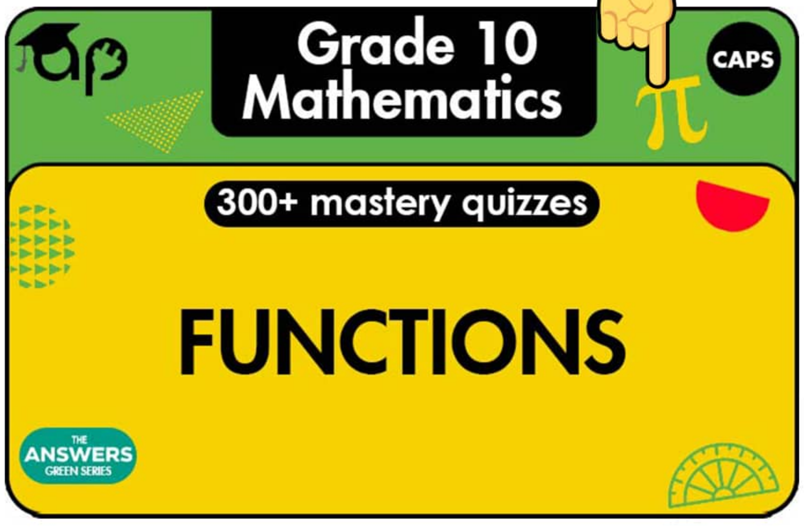

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CHAPTER 7
FUNCTIONS AND RELATIONSHIPS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
65	**A. Tables, Flow Diagrams and Functions**	2.2	• Determine input values, output values or rules for patterns and relationships using flow diagrams, tables, formulae and equations • Determine, interpret and justify equivalence of different descriptions of the same relationship or rule verbally, in flow diagrams, in tables, by formulae, by equations and by graphs on a Cartesian plane

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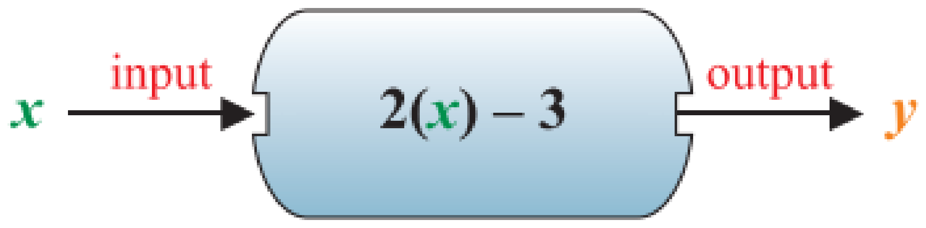
A. TABLES, FLOW DIAGRAMS AND FUNCTIONS

A **function is a rule** which **states the relationship** between an **input value** and an **output value**. These relationships can be expressed using:

- **Formulas**
- **Tables**
- **Flow Diagrams**

In this section we will call the input value x and the output value y.

Example 1: Examine the flow diagram below and answer the questions which follow.



a) Write down a rule in words for the flow diagram.
b) Write down a formula which can be used to represent the flow diagram.
c) Use the flow diagram or your formula to fill in the table below:

x	1	2	3	4	10	15	20
y							

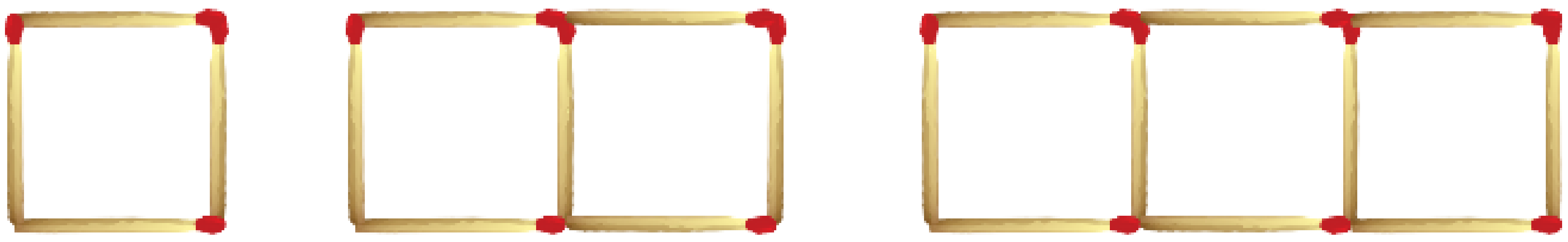
a) In order to obtain the output value (y), multiply the input value (x) by 2 and then subtract 3.

b) $y = 2x - 3$

c)

x	1	2	3	4	10	15	20
y	$y=2(1)-3$ -1	$y=2(2)-3$ 1	$y=2(3)-3$ 3	$y=2(4)-3$ 5	$y=2(10)-3$ 17	$y=2(15)-3$ 27	$y=2(20)-3$ 37

Example 2: Examine the geometric pattern below:



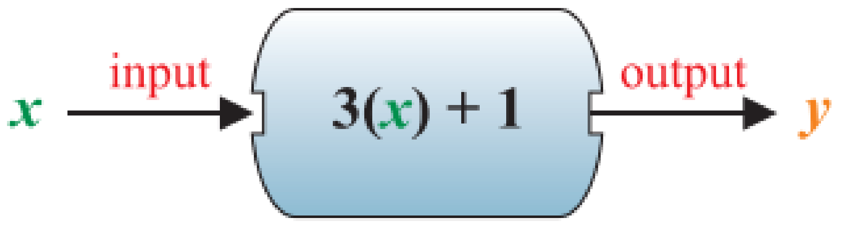
Pattern 1 Pattern 2 Pattern 3

a) Write a formula to represent the number of matches (x) in any pattern (y). Write your answer in the form $y = dx + c$ where d is the constant difference between terms.
b) Represent the pattern as a flow diagram

a) Pattern for number of matches: 4 ; 7 ; 10 ; …
Step 1: The constant difference between each term is **3**.
$\therefore y = 3x + c$
Step 2:
The first term is **4**. Determine the value of c, the number which has to be added to **3** (the constant difference) to obtain **4** (the first term).

$$\therefore c = 4 - 3$$
$$= 1$$
$$\therefore y = 3x + 1$$

b)



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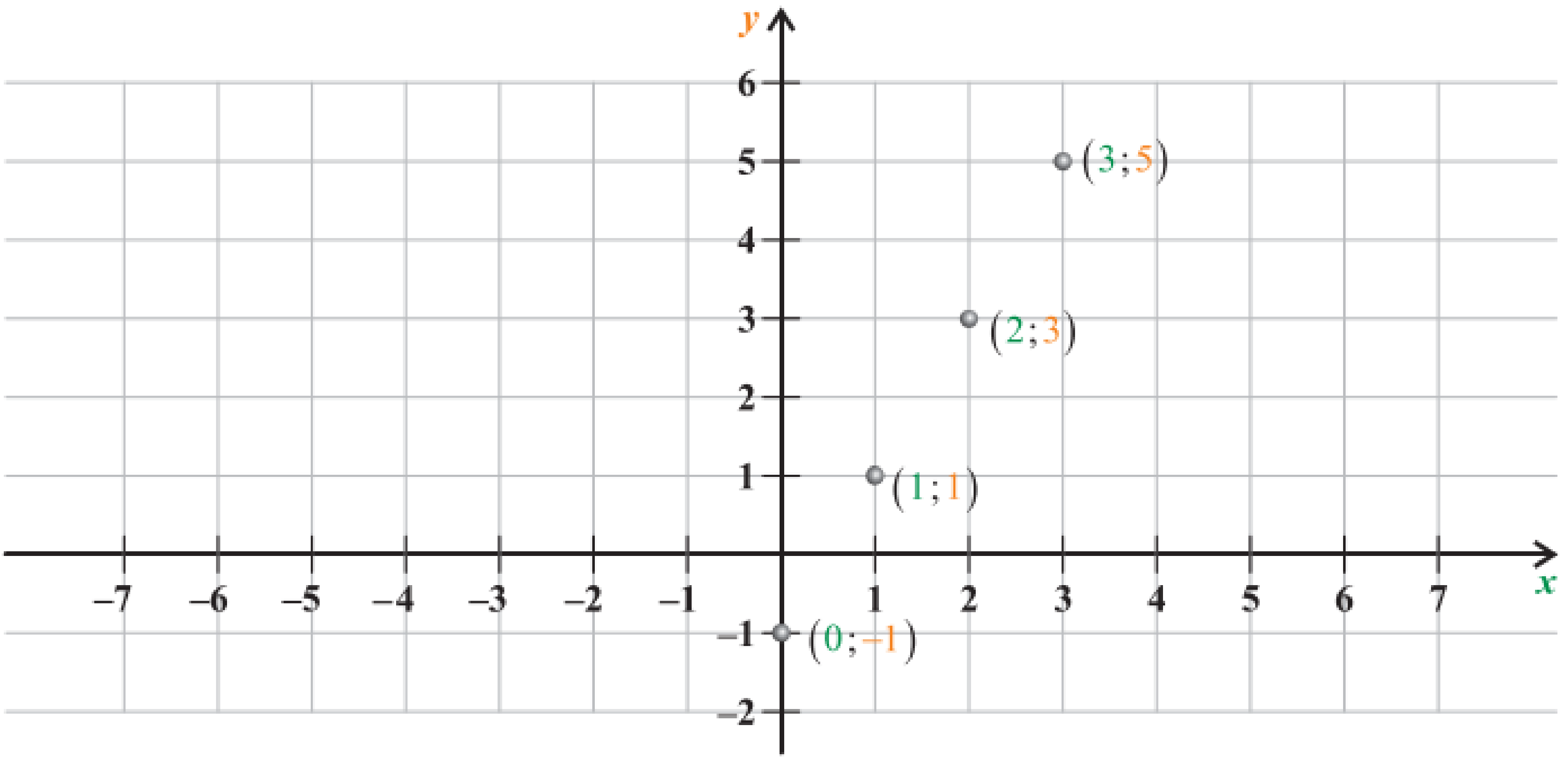
Example 3: **The graph below represents the relationship between input values (x) and output values (y).**



a) Fill in the table below using the graph above:

Input (x)	0			3
Output (y)		1	3	

b) Complete the table below and use it to draw a flow diagram which represents the relationship between the input and output variables.

Input (x)	0	1	2	3
(Input × 2) – 1				

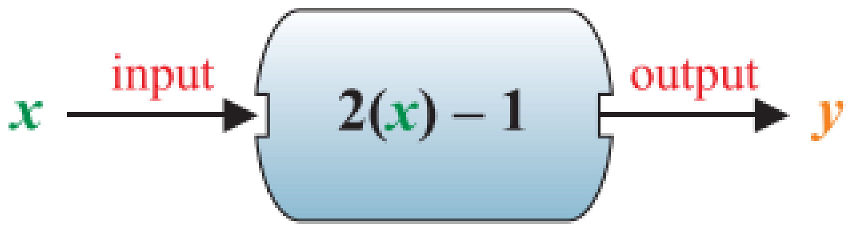
a) Input and output values can be read from the graph:

Input (x)	0	**1**	**2**	3
Output (y)	**–1**	1	3	**5**

b)

Input (x)	0	1	2	3
(Input × 2) – 1	0×2–1 –1	1×2–1 1	2×2–1 3	3×2–1 5

From the table it can be seen that the **output value (y)** = **(input value (x)** × **2) – 1**.
Therefore, the flow diagram is:



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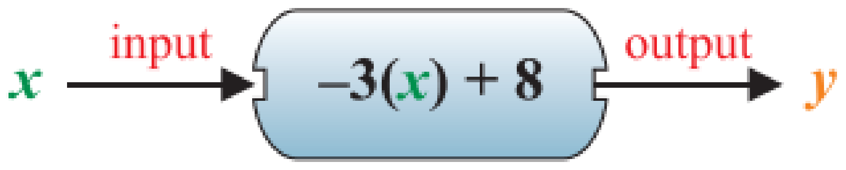
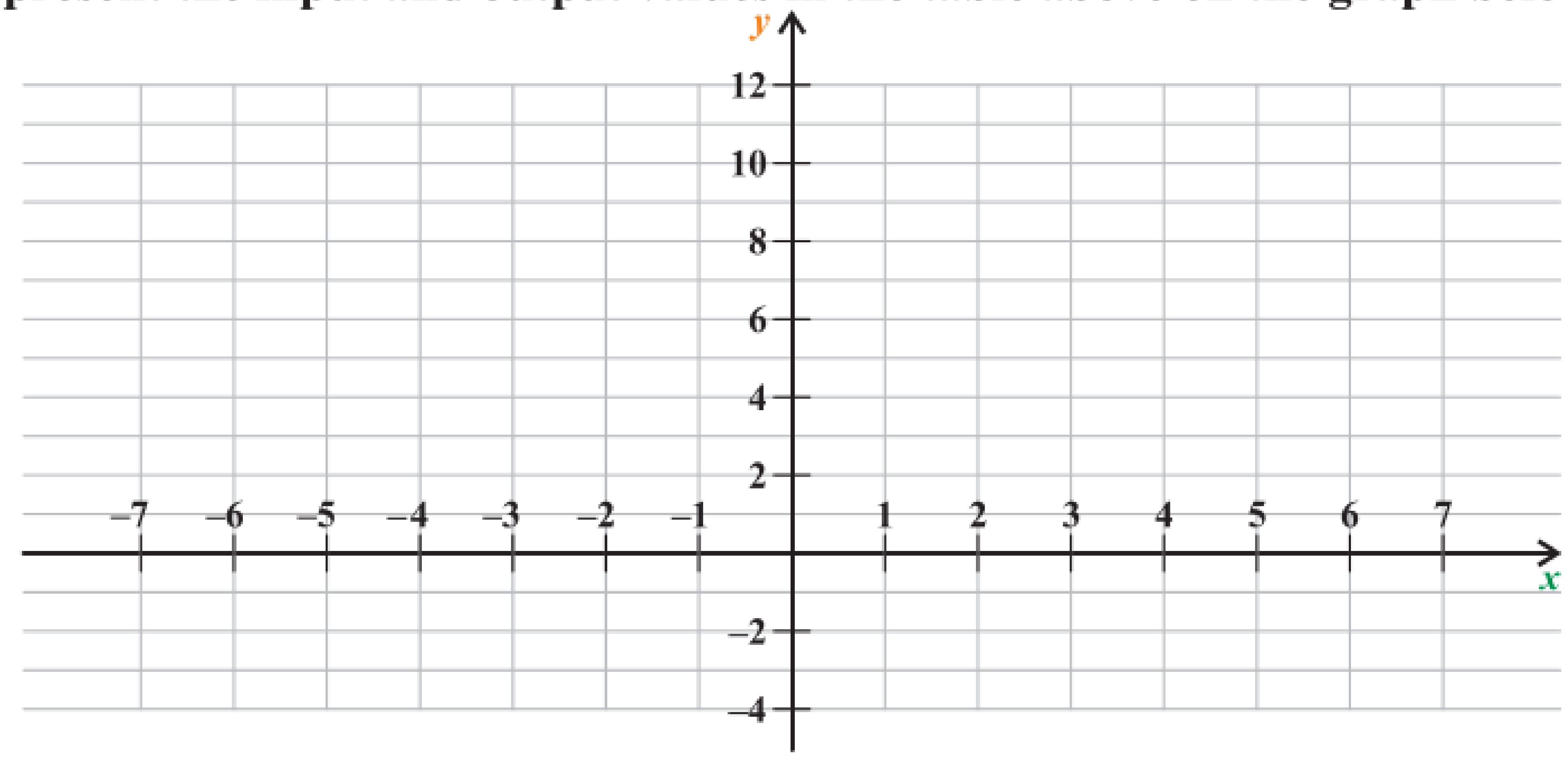
Example 4: **Given the flow diagram below:**



a) Use the flow diagram to fill in the table below:

Input (x)	–1	0	1	2	3	4
Output (y)						

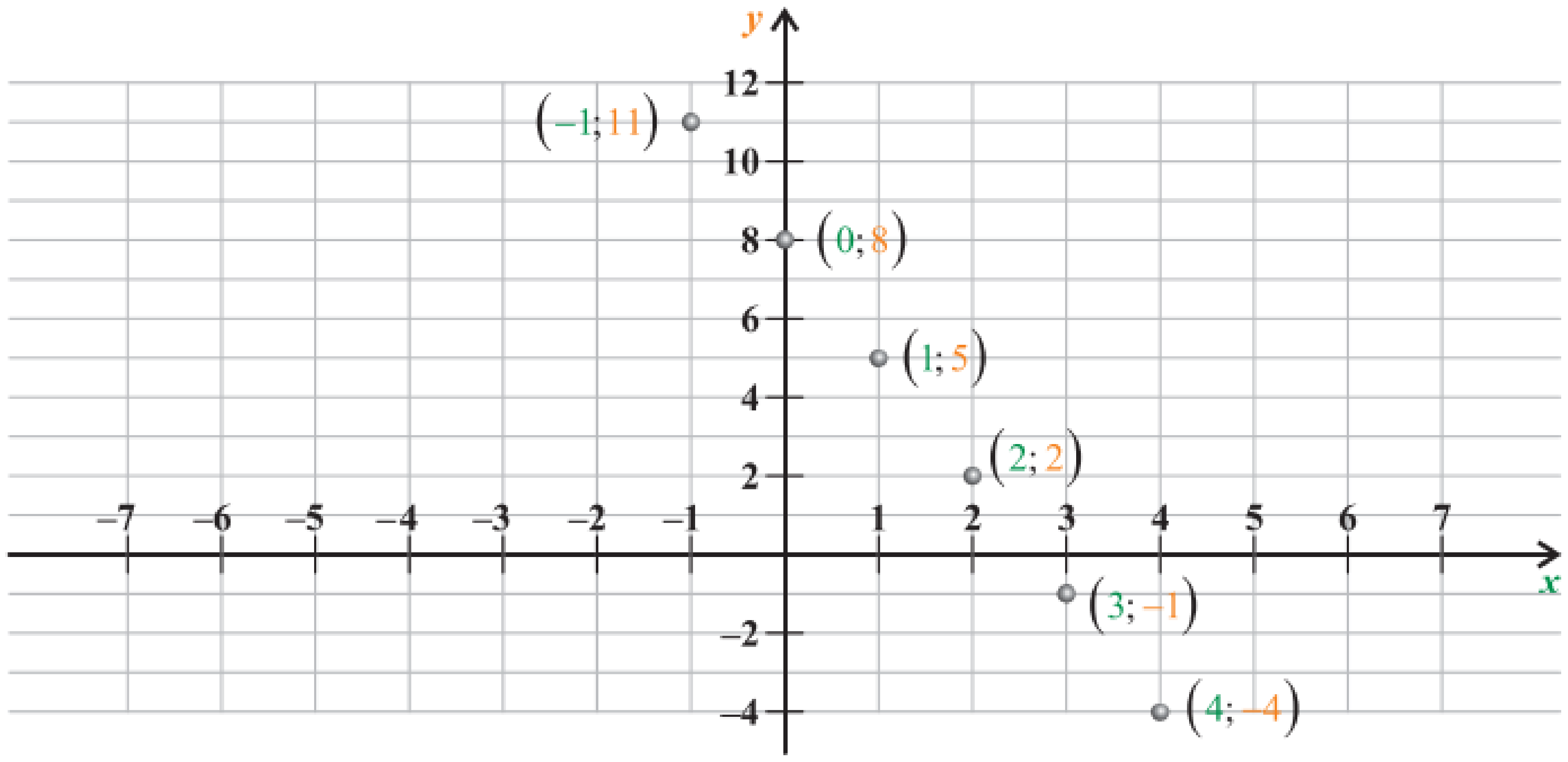
b) Represent the input and output values in the table above on the graph below:



a)

Input (x)	–1	0	1	2	3	4
Output (y)	$(-3\times-1)+8$ **11**	$(-3\times0)+8$ **8**	$(-3\times1)+8$ **5**	$(-3\times2)+8$ **2**	$(-3\times3)+8$ **–1**	$(-3\times4)+8$ **–4**

b)



Complete the Mixed Exercise on page 291.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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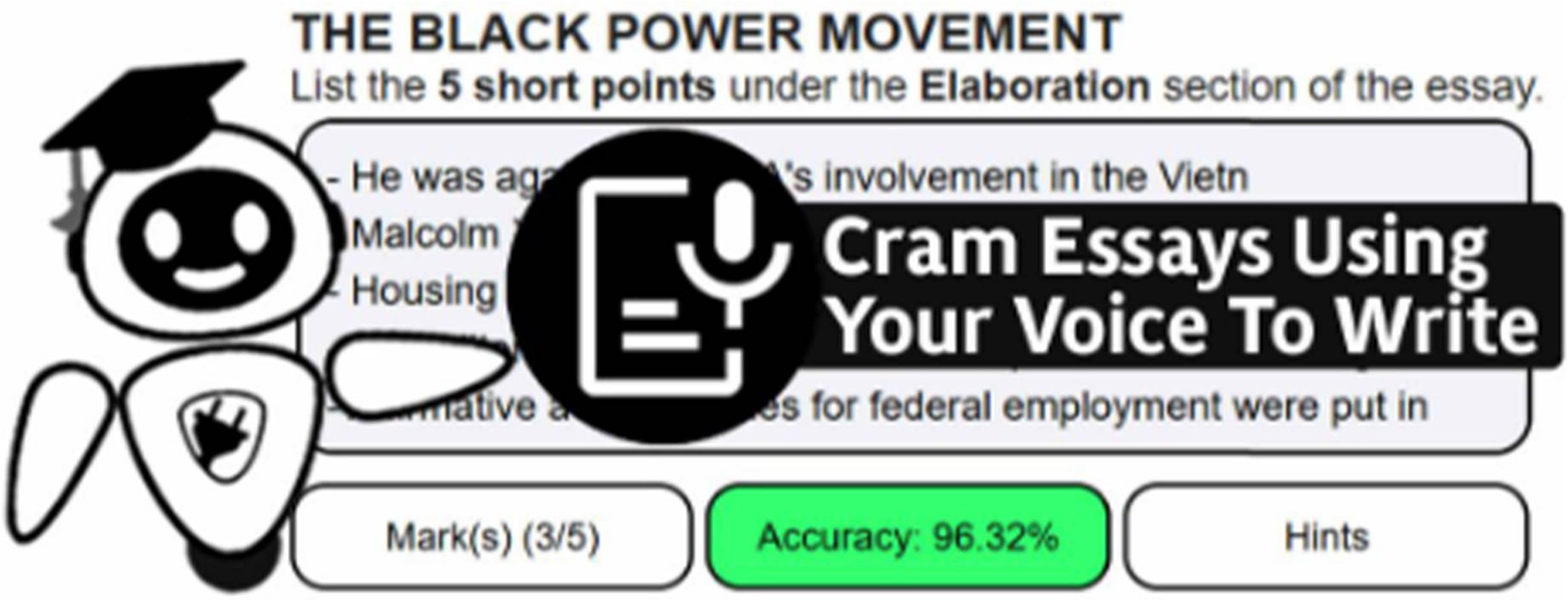

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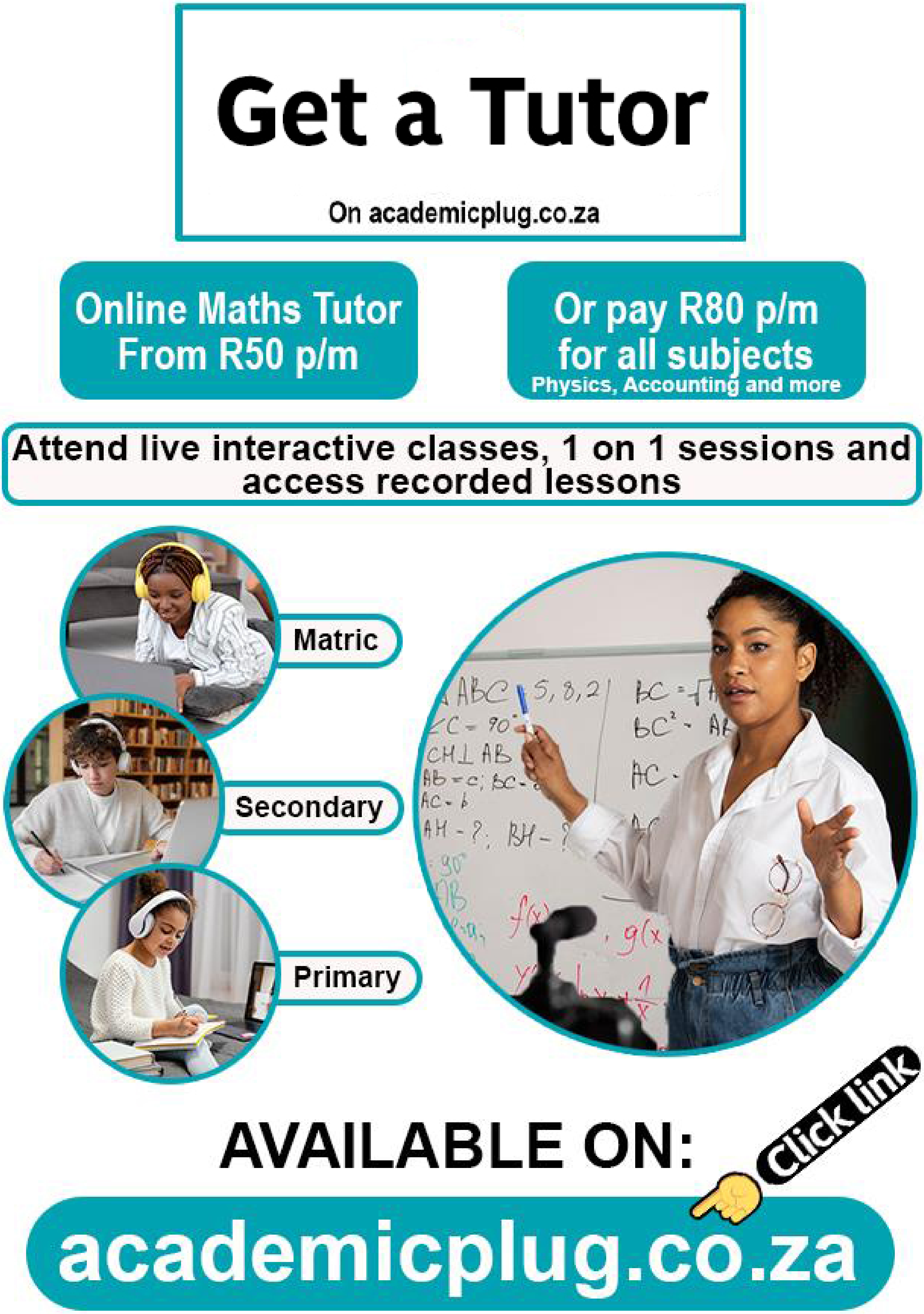
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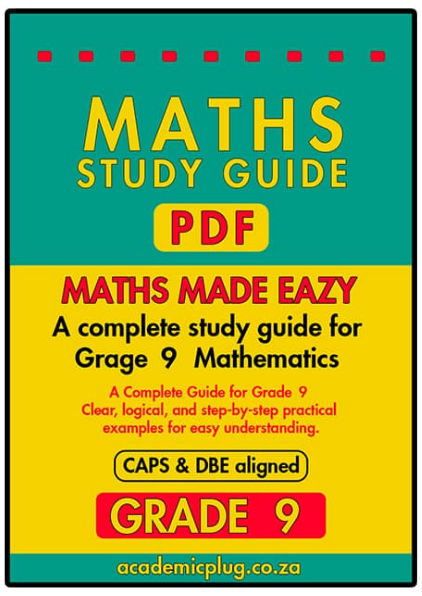

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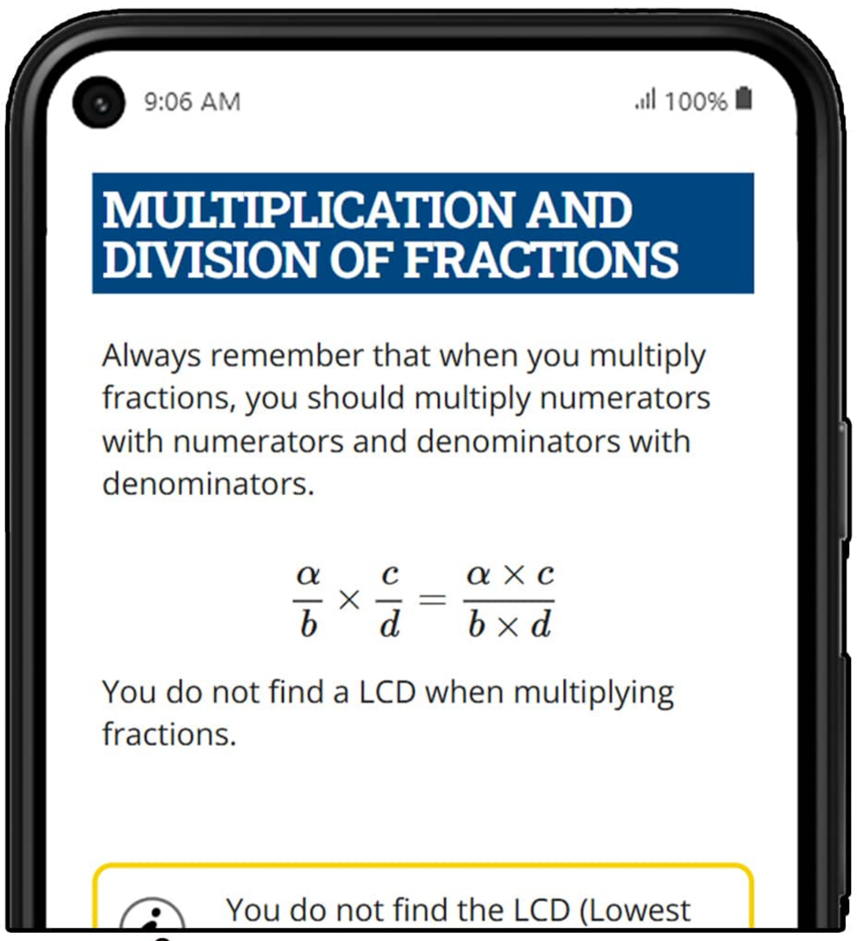

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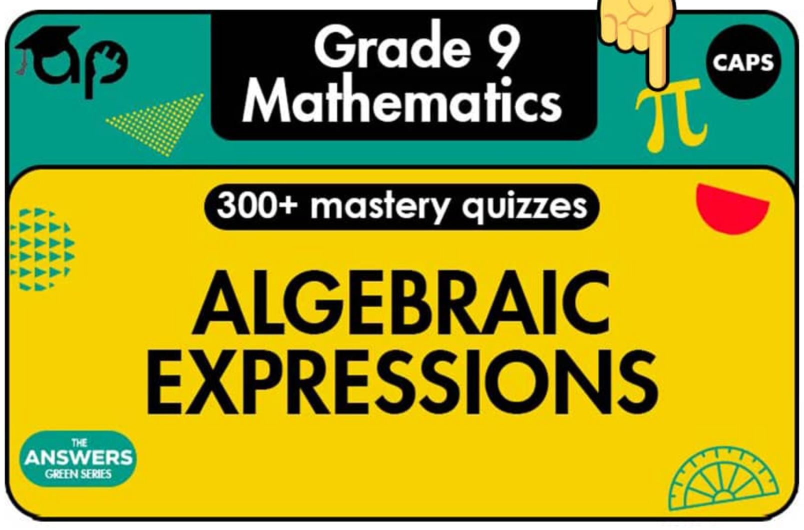

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CHAPTER 8
ALGEBRAIC EXPRESSIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
69 69 70 71 72 72 73 74 75 76	**A. Grade 8 Revision** • Terms in an Algebraic Expression • Polynomials • The Distributive Law • Addition and Subtraction of Polynomials • Substitution into Algebraic Expressions **B. The Product of Two Binomials** • Square Binomials • Binomials Which Differ in Sign • Mixed Examples	2.3	• Add and subtract like terms in algebraic expressions • Divide monomials, binomials and trinomials by integers or monomials • Multiply integers and monomials by monomials binomials trinomials • Simplify algebraic expressions • Determine the numerical value of algebraic expressions by substitution • Simplify the product of two binomials • Simplify the square of a binomial

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TERMS IN AN ALGEBRAIC EXPRESSION

In Grade 8 you learnt that **terms are separated by a plus or minus sign.**
A **term** in an algebraic expression can be a **single number** or a **combination of numbers and variables** (letters) **multiplied together**.

Example 1: Write down the number of terms in the following algebraic expressions.

a) 4
b) y
c) $y + 3$
d) $(q + 1)$
e) $(3a + 4b) + x$
f) $5a + 4b + c$
g) $(x + 3) - (y + 1)$
h) $(x + 3)(y + 1)$
i) $\dfrac{a+5}{y-2}$

a) **1 term**

b) **1 term**

c) $y + 3 \rightarrow$ there are 2 terms seperated by a plus sign
Therefore, there are **2 terms**.

d) $(q + 1)$
There are two terms inside the brackets. However, the brackets group the terms together and they are considered 1 term.
Therefore, there is **1 term**.

e) $(3a + 4b) + x$
The above expression has **2 terms** separated by a plus sign.
Therefore, there are **2 terms**.
Remember that anything inside a bracket counts as 1 term.

f) $5a + 4b + c$
The above expression has **3 terms** separated by plus signs.
Therefore, there are **3 terms**.

g) $(x + 3) - (y + 1)$
Each bracket in the above expression counts as 1 term. These are separated by a minus sign.
Therefore, there are **2 terms**.

h) $(x + 3)(y + 1)$
Although there are two brackets in the above expression, they are **not** separated by a plus or minus sign. If **numbers**, **variables** or **brackets** are multiplied together they are considered **1 term**.
Therefore, there is **1 term** in the above expression.

i) **1 term**.
A **single fraction** is always considered **1 term**, no matter how many terms there are in the numerator (the numbers on top) or the denominator (the numbers at the bottom).

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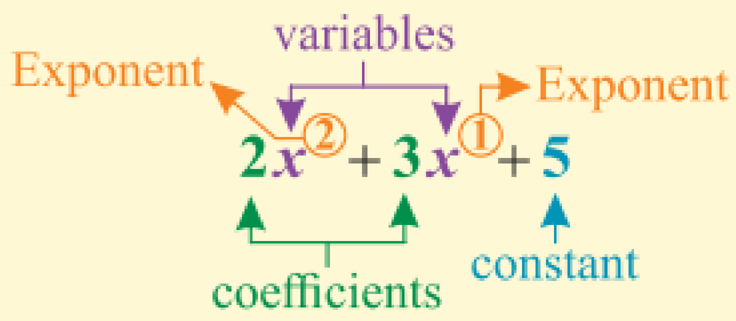
POLYNOMIALS

A **polynomial** is an **algebraic expression** which consists of **one or more terms**.
There are specific names given to polynomials with one, two and three terms.
A **monomial** is a polynomial consisting of **one term**. For example, 2 or $2x$ or $2x^2$.
A **binomial** is a polynomial consisting of **two terms**. For example, $2 + x$ or $2x + 1$.
A **trinomial** is a polynomial consisting of **three terms**. For example, $2 + x - 3$.

There are 5 main components of a polynomial which are shown below:



- **Variables** (letters used to represent numbers)
- **Coefficients** (the number next to a variable in a term)
- **Constant terms** (the term with no variable)
- **Exponents** (the number a variable is raised to)
- **Degree of a polynomial (the highest exponent of any variable in an expression)**

Example 1: Examine the polynomial $5x^2 + y + 10$.

a) What type of polynomial is shown above?
b) What is the coefficient of x^2?
c) What is the coefficient of y?
d) What are the variables in the above polynomial?
e) What is the constant term?
f) What is the degree of the expression?

a) A trinomial → there are 3 terms in the expression
b) 5
c) 1 → if the coefficient is not shown the coefficient is equal to 1
d) x and y.
e) 10
f) 2 → the largest exponent of the variable x is 2

Example 2: Examine the polynomial $2x^3 - 5x^2 + x$.

a) What is the coefficient of x^3?
b) What is the coefficient of x^2?
c) What is the constant term in the expression?
d) What is the degree of the expression?

a) 2
b) -5 → the negative sign belongs to the coefficient
c) 0 → If the constant is not shown it is 0
d) 3 → the largest exponent of the variable x is 3

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THE DISTRIBUTIVE LAW

In Grade 8 you learnt that the distributive law states that:

$$x(a+b+c)=ax+bx+cx$$

When using the distributive law, the **number in front of the bracket** must be **multiplied by every number inside the bracket**.

Example 1: $5(3x-1)+4(x+2)$

$5(3x-1)+4(x+2) \rightarrow$ distribute into the brackets

$=15x-5+4x+8 \rightarrow$ add like terms

$=19x+3$

Example 2: $4(2p-5)-3(p-1)$

$4(2p-5)-3(p-1) \rightarrow$ the negative must also be distributed into the bracket

$=8p-20-3p+3 \rightarrow$ add like terms

$=5p-17$

Example 3: $-3(2y+3)-(4y-2)$

$-3(2y+3)-(4y-2) \rightarrow$ if there is no number before the bracket the number is a 1

$=-6y-9-4y+2 \rightarrow$ add like terms

$=-10y-7$

Example 4: $6-5(2a+2)$

$6-5(2a+2) \rightarrow$ you have to do mulitplication first

$=6-10a-10 \rightarrow$ add like terms

$=-4-10a$

In example 4 above it is incorrect to subtract the 5 from the 6 before using the distributive law. It would be incorrect to do the example as follows:

$6-5(4x+2)$

$=1(4x+2) \rightarrow$ this is incorrect, do not do this!

Example 5: $3(4p-1)-2$

$3(4p-1)-2 \rightarrow$ do multiplication first, use the distributive law

$=12p-3-2$

$=12p-5$

Example 6: $3+(4p-1)(2)$

$3+(4p-1)(2) \rightarrow$ do multiplication first, use the distributive law

$=3+8p-2 \rightarrow$ add like terms

$=1+8p$

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ADDITION AND SUBTRACTION OF POLYNOMIALS

Example 1: Add x^2+2x+4 to $3x^2-4x-5$

$x^2+2x+4+3x^2-4x-5 \rightarrow$ add like terms

$=4x^2-2x-1$

Example 2: Subtract $3x^2-2x-1$ from $-2x^2+7x-5$

$-2x^2+7x-5-\left(3x^2-2x-1\right) \rightarrow$ always use brackets when subtracting polynomials

$=-2x^2+7x-5-3x^2+2x+1 \rightarrow$ don't forget to distribute the '$-$', now add like terms

$=-5x^2+9x-4$

Example 3: From $6y^2+3y-2$ subtract the sum of $-3y^2+2y+3$ and $2y^2+y+1$

$6y^2+3y-2-\left(-3y^2+2y+3+2y^2+y+1\right) \rightarrow$ use brackets when subtracting

$=6y^2+3y-2+3y^2-2y-3-2y^2-y-1 \rightarrow$ don't forget to distribute the '$-$', now add like terms

$=7y^2+0y-6$

$=7y^2-6$

SUBSTITUTION INTO ALGEBRAIC EXPRESSIONS

Example: Determine the value of the following expressions if:
$p=3$, $q=2$ and $r=-2$.

a) $3p^2+2q-2r$

b) $r^3-p-r+q+2$

a) $3p^2+2q-2r \rightarrow$ replace every p with a 3, every q with a 2 and every r with a -2

$=3(3)^2+2(2)-2(-2)$

$=3(9)+4+4 \rightarrow$ a '$-$' $\times$ '$-$' is a '$+$'

$=27+8$

$=35$

b) $r^3-p-r+q+2 \rightarrow$ replace every p with a 3, every q with a 2 and every r with a -2

$=(-2)^3-(3)-(-2)+(2)+2$

$=-8-3+2+4 \rightarrow$ a '$-$' $\times$ '$-$' is a '$+$'

$=-5$

Complete Exercise 1 on page 294.

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When **two binomials are multiplied** by each other, **each term in first bracket has to be multiplied by each term in the second bracket**.

$$(a+b)(x+y) = ax + ay + bx + by$$

<u>Example 1</u>: Expand and simplify $(x+2)(x+3)$.

$$(x+2)(x+3)$$

$= x^2 + 3x + 2x + 6 \rightarrow$ add like terms together $(3x+2x)$

$= x^2 + 5x + 6$

<u>Example 2</u>: Expand and simplify $(x-5)(x-4)$.

$$(x-5)(x-4)$$

$= x^2 - 4x - 5x + 20 \rightarrow$ a '−' × '−' is a '+', add like terms together $(-4x-5x)$

$= x^2 - 9x + 20$

<u>Example 3</u>: Expand and simplify $(x-7)(x+2)$.

$$(x-7)(x+2)$$

$= x^2 + 2x - 7x - 14 \rightarrow$ a '−' × '+' is a '−', add like terms together $(+2x-7x)$

$= x^2 - 5x - 14$

<u>Example 4</u>: Expand and simplify $(3x-5y)(2x+2y)$.

$$(3x-5y)(2x+2y)$$

$= 6x^2 + 6xy - 10xy - 10y^2 \rightarrow$ a '−' × '+' is a '−', add like terms together $(+6xy-10xy)$

$= 6x^2 - 4xy - 10y^2$

Expanding the product of binomials is often taught as FOIL.
(First Outers Inners Last)

Complete Exercise 2 on page 294.

SQUARE BINOMIALS

Square binomial are binomials in the form of: $(a+b)^2$ **or** $(a-b)^2$

Square binomials can be expanded as shown below:

$$(a+b)^2 = (a+b)(a+b)$$
$$= a^2 + ab + ab + b^2$$
$$= a^2 + 2ab + b^2$$

$$(a-b)^2 = (a-b)(a-b)$$
$$= a^2 - ab - ab + b^2$$
$$= a^2 - 2ab + b^2$$

It can be seen that a **general expression for squaring a binomial** is:

$$(\text{term 1} + \text{term 2})^2 = (\text{term 1})^2 + 2(\text{term 1} \times \text{term 2}) + (\text{term 2})^2$$

There always has to be a middle term when squaring a binomial.

Example 1: Expand and simplify $(x-4)^2$.

$x \times -4 \times 2 = -8x$

$$(x-4)^2 = x^2 - 8x + 16$$

Example 2: Expand and simplify $(2x+3y)^2$.

$2x \times 3y \times 2 = 12xy$

$$(2x+3y)^2 = 4x^2 + 12xy + 9y^2$$

Example 3: Expand and simplify $(5x-3)^2$.

$5x \times -3 \times 2 = -30x$

$$(5x-3)^2 = 25x^2 - 30x + 9$$

Example 4: Expand and simplify $(7x+1)^2$.

$7x \times 1 \times 2 = 14x$

$$(7x+1)^2 = 49x^2 + 14x + 1$$

Example 5: Expand and simplify $(2a+11)^2$.

$2a \times 11 \times 2 = 44a$

$$(2a+11)^2 = 4a^2 + 44a + 121$$

Complete Exercise 2 number 2 on page 294.

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BINOMIALS WHICH DIFFER IN SIGN

Binomials which **differ in sign** are binomials in the form of: $(a-b)(a+b)$

In this case the two **brackets are exactly the same, except** they **differ in sign**.
The expansion of these type of binomials is shown below:

$$(a-b)(a+b) = a^2 + ab - ab - b^2$$
$$= a^2 - b^2 \rightarrow \text{no middle term}$$

In this case, the sum of the two middle terms is always equal to 0 and there is no middle term.

<u>Example 1</u>: Expand and simplify $(x-4)(x+4)$.

$(x-4)(x+4)$

$= x^2 - 16 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

<u>Example 2</u>: Expand and simplify $(2x-3y)(2x+3y)$.

$(2x-3y)(2x+3y)$

$= 4x^2 - 9y^2 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

<u>Example 3</u>: Expand and simplify $(4x+2)(4x-2)$.

$(4x+2)(4x-2)$

$= 16x^2 - 4 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

<u>Example 4</u>: Expand and simplify $(7x+11)(7x-11)$.

$(7x+11)(7x-11)$

$= 49x^2 - 121 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

<u>Example 5</u>: Expand and simplify $(9x-12y)(9x+12y)$.

$(9x-12y)(9x+12y)$

$= 81x^2 - 144y^2 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

<u>Example 6</u>: Expand and simplify $[(x-y)+2][(x-y)-2]$.

$[(x-y)+2][(x-y)-2] \rightarrow (x-y)$ is term 1

$= (x-y)^2 - 4 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

$= x^2 - 2xy + y^2 - 4 \rightarrow$ don't forget the middle term

<u>Example 7</u>: Expand and simplify $[(2a-b)+3][(2a-b)-3]$.

$[(2a-b)+3][(2a-b)-3] \rightarrow (2a-b)$ is term 1

$= (2a-b)^2 - 9 \rightarrow (\text{term } 1)^2 - (\text{term } 2)^2$

$= 4a^2 - 4ab + b^2 - 9 \rightarrow$ don't forget the middle term

Complete Exercise 2 number 3 on page 295.

MIXED EXAMPLES

Example 1: Expand and simplify $2(x-2)^2+(5x+1)(x+6)$.

$2(x-2)^2+(5x+1)(x+6) \rightarrow$ square before distributing the 2, multiply out the binomial

$=2(x^2-4x+4)+5x^2+30x+x+6 \rightarrow$ distribute the 2 and add like terms

$=2x^2-8x+8+5x^2+31x+6 \rightarrow$ add like terms

$=7x^2+23x+14$

Example 2: Expand and simplify $-(x-2)(x+2)+(3x+1)^2$.

$-(x-2)(x+2)+(3x+1)^2 \rightarrow$ same brackets with different signs, square binomial

$=-(x^2-4)+9x^2+6x+1 \rightarrow$ now distribute the '$-$'

$=-x^2+4+9x^2+6x+1$

$=8x^2+6x+5 \rightarrow$ like terms were added together

Example 3: Expand and simplify $\left(\frac{x}{3}+3\right)^2$.

$\frac{x}{3}\times\frac{3}{1}\times\frac{2}{1}=2x$ (×2)

$\left(\frac{x}{3}+3\right)^2=\frac{x^2}{9}+2x+9 \rightarrow \left(\frac{x}{3}\right)^2=\frac{(x)^2}{(3)^2}=\frac{x^2}{9}$

Example 4: Expand and simplify $-2(x-3)(x+3)+(3x+1)(2x+5)$.

$-2(x-3)(x+3)+(3x+1)(2x+5) \rightarrow$ same brackets with different signs, multiply out

$=-2(x^2-9)+6x^2+15x+2x+5 \rightarrow$ now distribute the '-2' and add like terms

$=-2x^2+18+6x^2+17x+5$

$=4x^2+17x+23 \rightarrow$ like terms were added together

Example 5: Expand and simplify $[2x-(3x+y)]^2$.

$[2x-(3x+y)]^2 \rightarrow$ distribute the '$-$' first

$=(2x-3x-y)^2 \rightarrow$ add like terms

$=(-x-y)^2$

$=x^2+2xy+y^2 \rightarrow$ don't forget the middle term, $-x\times-y\times2=+2xy$

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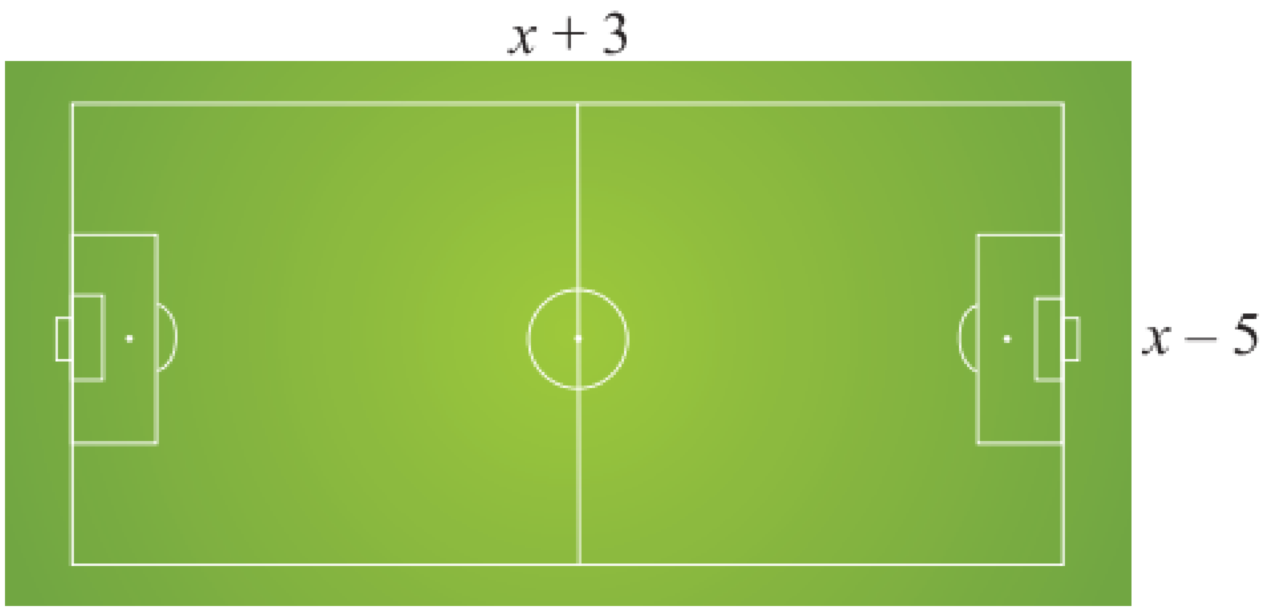
<u>Example 6</u>: The rectangular soccer field below has a length of $x + 3$ metres and a width of $x - 5$ metres.



a) Determine the perimeter of the soccer field in terms of x.
b) Determine the area of the soccer field in terms of x.

Useful Formulas:

$$\text{Perimeter of a rectangle} = 2(\text{length}) + 2(\text{breadth})$$

$$\text{Area of a rectangle} = \text{length} \times \text{breadth}$$

a)

$$\begin{aligned}\text{Perimeter} &= 2(\text{length}) + 2(\text{breadth})\\ &= 2(x+3) + 2(x-5)\\ &= 2x + 6 + 2x - 10\\ &= 4x - 4\end{aligned}$$

b)

$$\begin{aligned}\text{Area} &= (\text{length}) \times (\text{breadth})\\ &= (x+3)(x-5)\\ &= x^2 - 5x + 3x - 15\\ &= x^2 - 2x - 15\end{aligned}$$

Be careful not to make the common errors shown below:

$x + x = 2x$ **not** x^2

$x^2 + x^2 = 2x^2$ **not** $2x^4$

$a + b = a + b$ **not** ab

$(2x^2)^3 = 8x^6$ **not** $6x^5$

Complete the Mixed Exercise on page 295.

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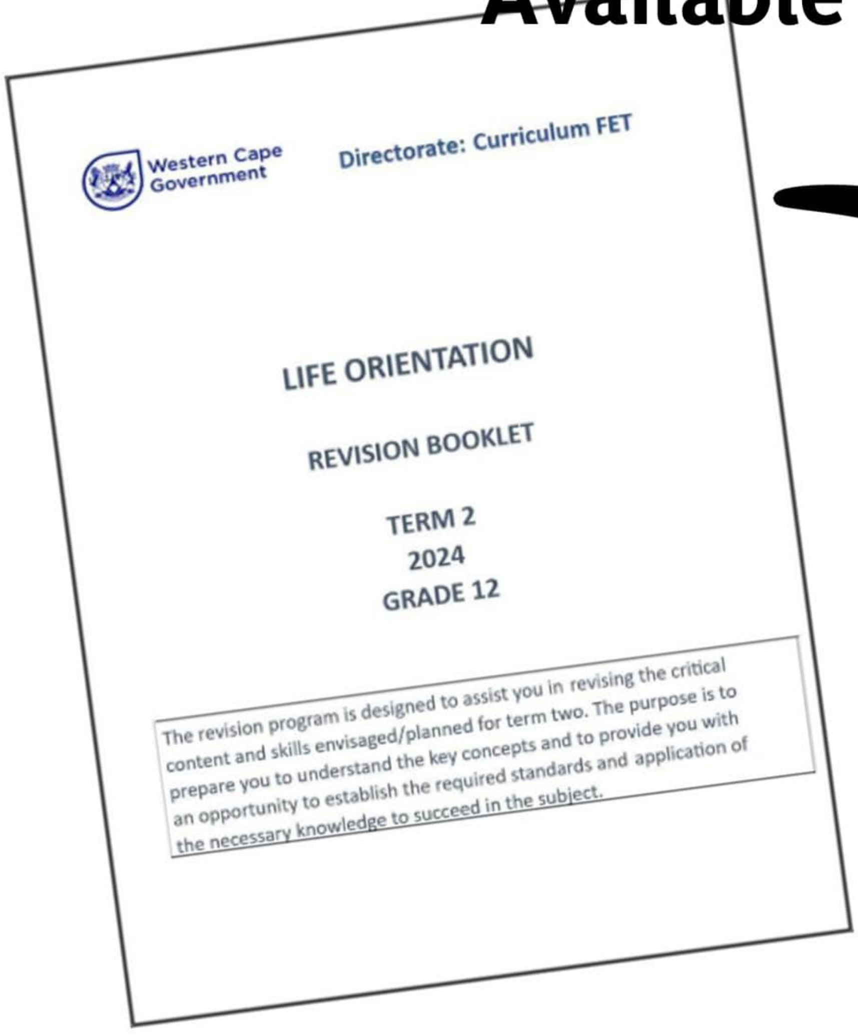

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TERM 2
2024
GRADE 12

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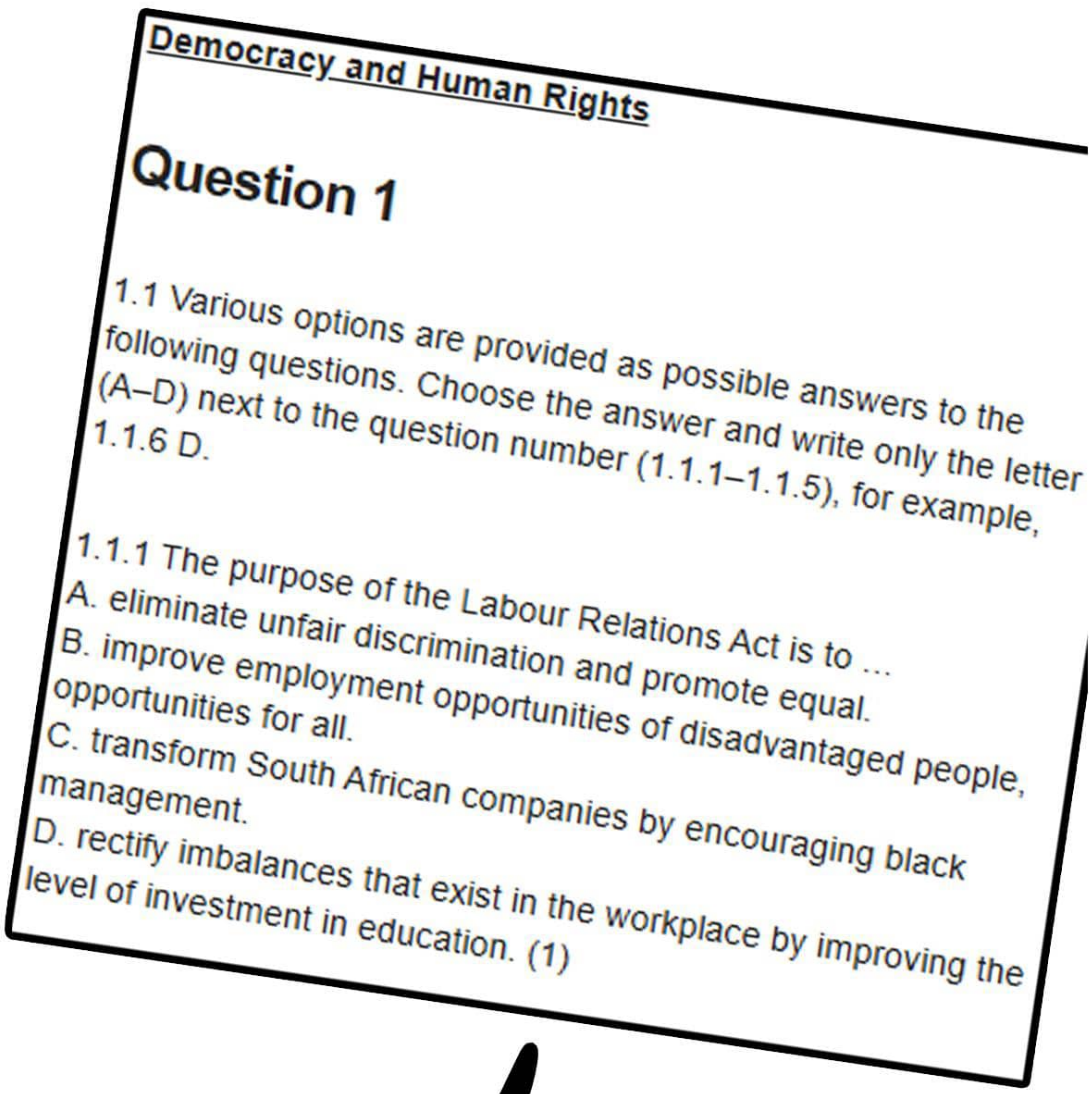
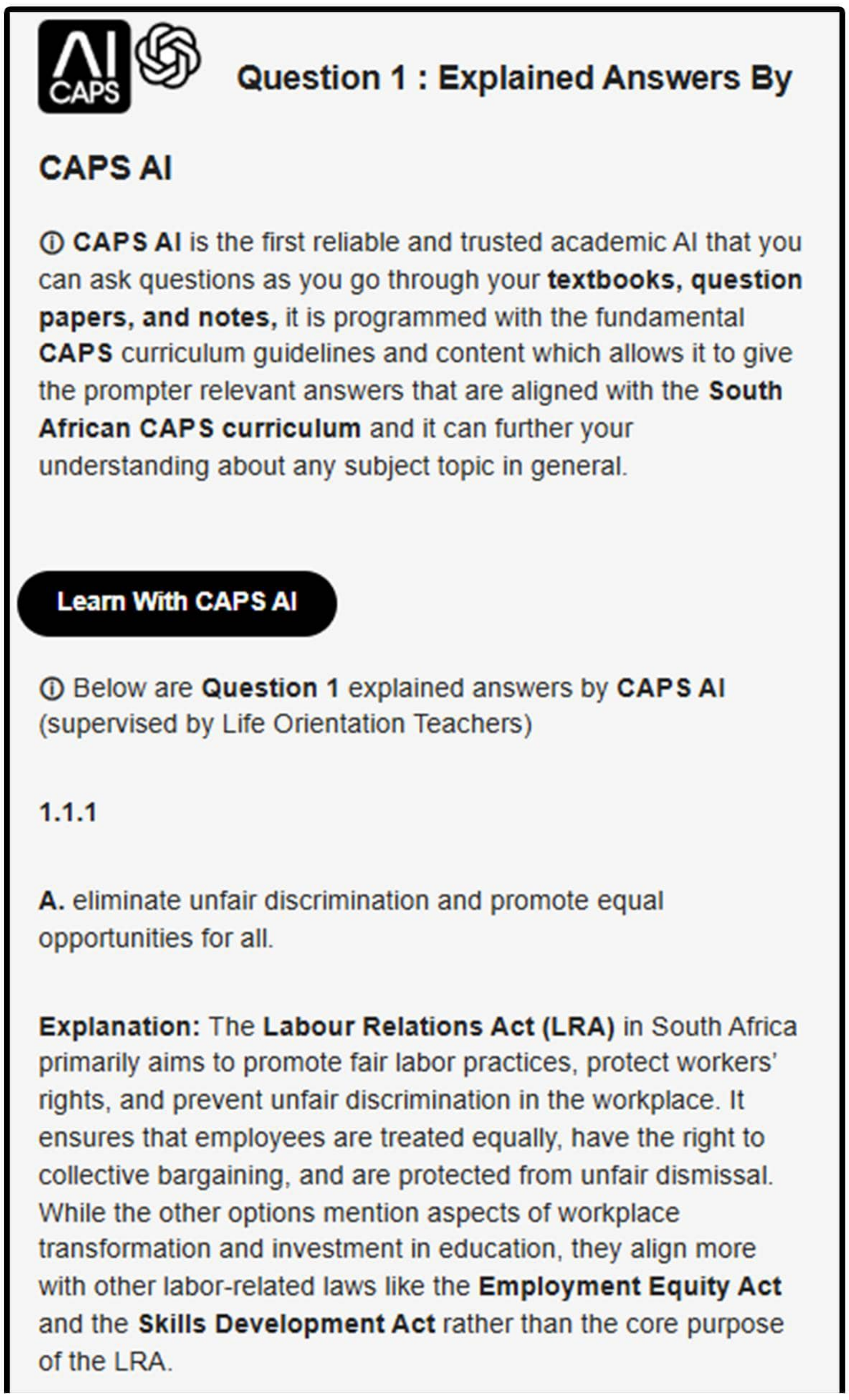


Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)



Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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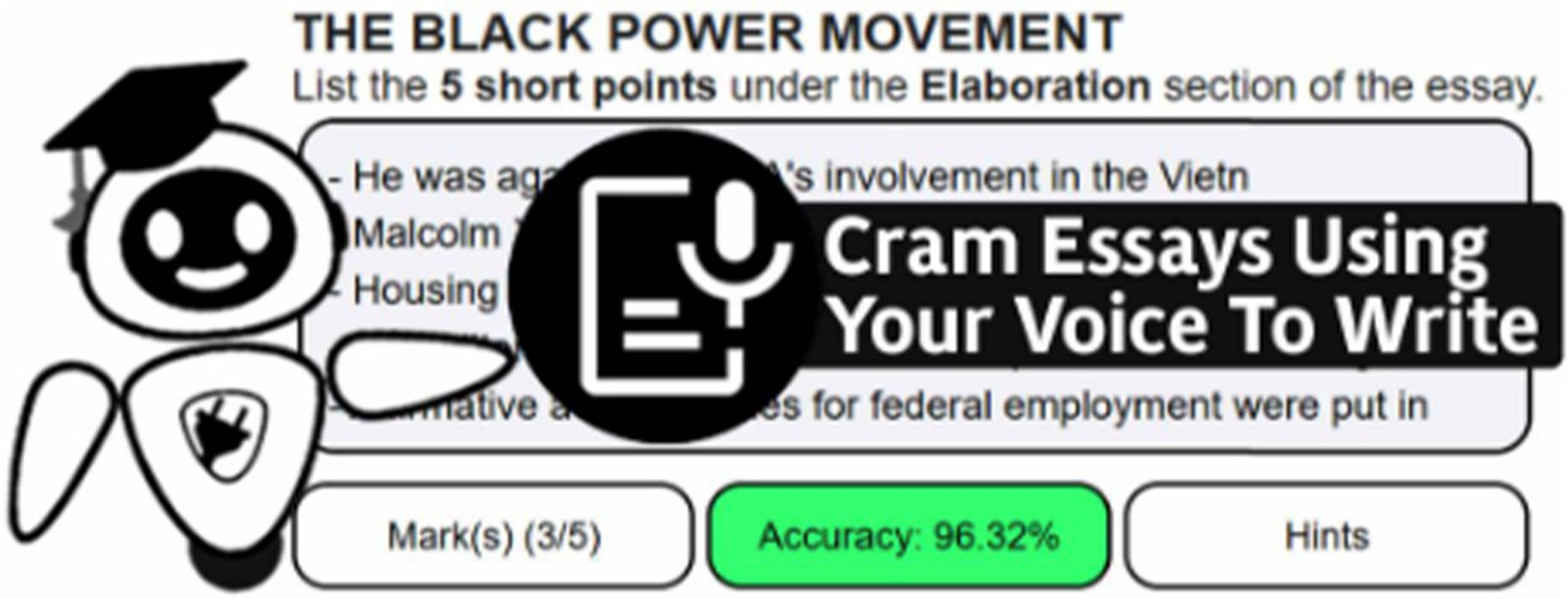

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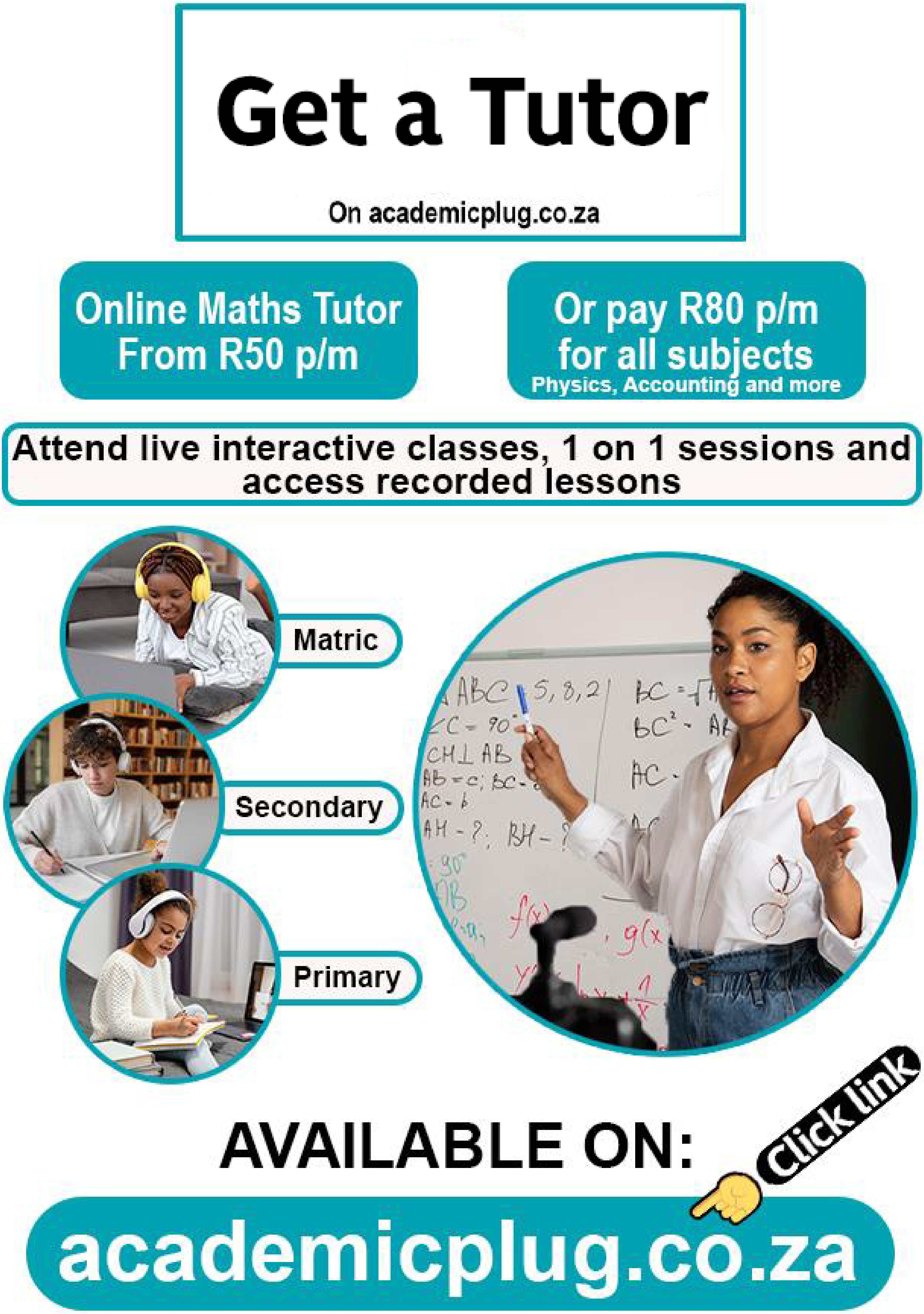
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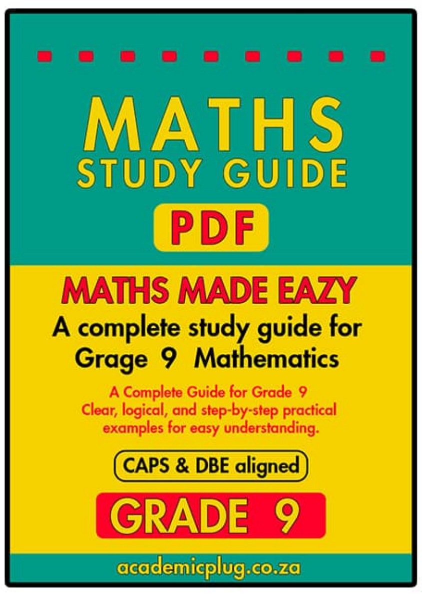

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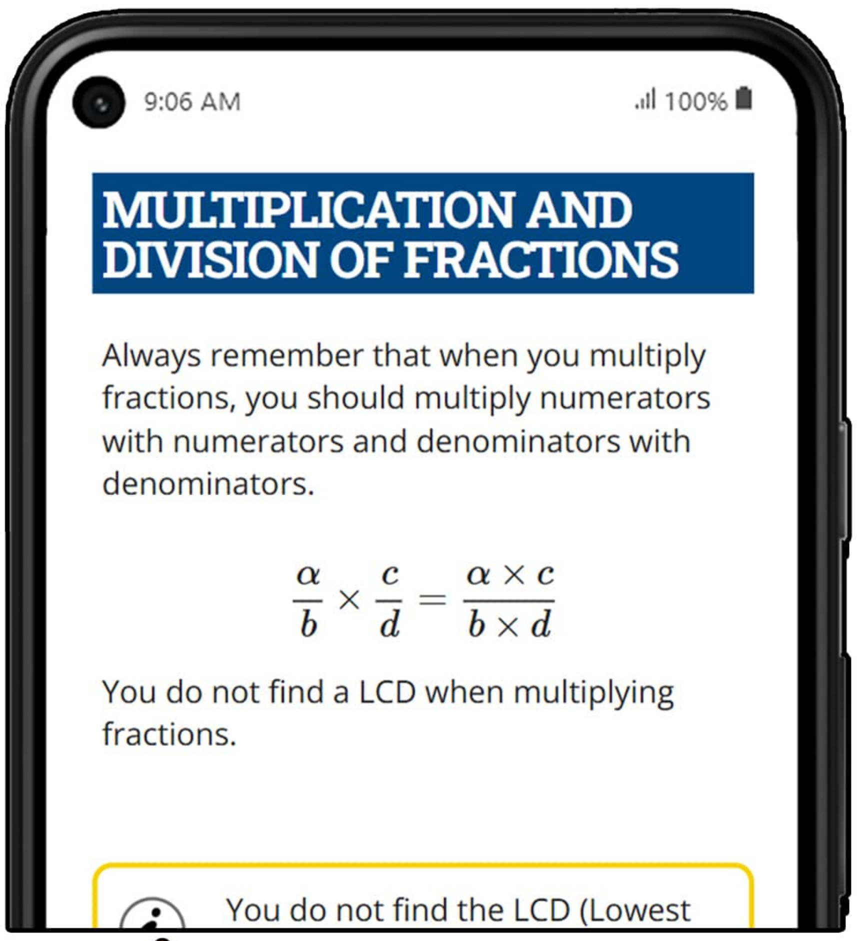

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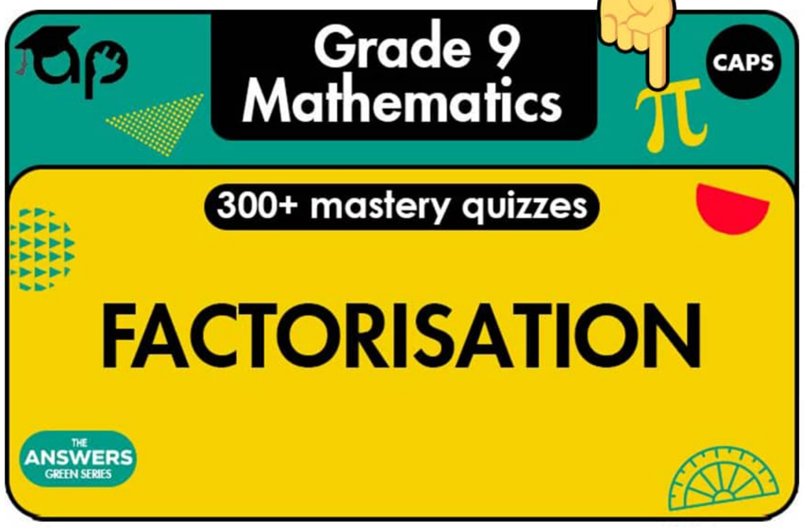

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CHAPTER 9
FACTORISATION AND SIMPLIFICATION OF ALGEBRAIC EXPRESSIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
79	**A. Factorisation**	2.3	• Factorize algebraic expressions that involve common factors, difference of two squares and trinomials • Simplify algebraic expressions that involve the above factorisation processes • Simplify algebraic fractions using factorisation • Divide polynomials by integers or monomials
79	• Factorising by taking out a Highest Common Factor		
80	• Taking out a Bracket as a HCF		
80	• Taking out a Minus		
82	**B. Factorisation of The Difference of Two Squares (DOTS)**		
84	• Taking out a HCF with Difference of Squares		
84	• Difference of Squares which Factorise Further		
85	**C. Factorisation of Trinomials**		
89	**D. Simplifying Algebraic Expressions**		

According to CAPS this chapter should be covered in Term 3. However, from practical experience, most teachers choose to cover Factorisation after Algebraic Expressions which were covered in Chapter 8.

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A. FACTORISATION

FACTORISING BY TAKING OUT A HIGHEST COMMON FACTOR

In the previous chapter you saw that $a(b+c)$ can be multiplied using the distributive law. Using the distributive law $a(b+c)=ab+ac$.

Factorisation reverses this process. Starting with $ab+ac$, a **is common to both terms**. This means you can **take out a Highest Common Factor (HCF) of** a.

$$ab+ac=a(b+c)$$

When taking out a HCF, every term in the expression is divided by the HCF.

Example 1: Factorise $2x+4$.

$2x+4 \rightarrow$ 2 is a HCF of 2 and 4

$=2(x+2)$

Example 2: Factorise $3ax+4bx$.

$3ax+4bx \rightarrow x$ is common to both terms

$=x(3a+4b)$

Example 3: Factorise $6x^2+9x$.

$6x^2+9x \rightarrow x$ is the HCF of x and x^2, 3 is the HCF of 6 and 9

$=3x(2x+3)$

Example 4: Factorise $8a^4+16a^3$.

$8a^4+16a^3 \rightarrow a^3$ is the HCF of a^4 and a^3, 8 is the HCF of 8 and 16

$=8a^3(a+2)$

Example 5: Factorise $2p^2+4p^3$.

$2p^2+4p^3 \rightarrow p^2$ is the HCF of p^2 and p^3, 2 is the HCF of 2 and 4

$=2p^2(1+2p) \rightarrow$ you have to write the 1 as $\dfrac{2p^2}{2p^2}=1$

Example 6: Factorise x^2y+xy^2.

$x^2y+xy^2 \rightarrow xy$ is the HCF of x^2y and xy^2

$=xy(x+y)$

Example 7: Factorise $8p^2q+16p^3-4p^2$.

$8p^2q+16p^3-4p^2 \rightarrow p^2$ is the HCF of p^2 and p^3, 4 is the HCF of 4, 8 and 16

$=4p^2(2q+4p-1) \rightarrow$ you have to write the 1

Complete Exercise 1 number 1 on page 300.

TAKING OUT A BRACKET AS A HCF

Example 1: **Factorise** $2(x+4)-x(x+4)$.

$2(x+4)-x(x+4) \rightarrow x+4$ is common to both terms

$=(x+4)(2-x)$

Example 2: **Factorise** $a(y-2)+b(y-2)$.

$a(y-2)+b(y-2) \rightarrow y-2$ is common to both terms

$=(y-2)(a+b)$

Example 3: **Factorise** $x(p-q)+(p-q)$.

$x(p-q)+(p-q) \rightarrow p-q$ is common to both terms

$=(p-q)(x+1) \rightarrow$ you have to write the 1

It is important to note that in example 3 above, if there is no number or variable in front of the bracket, the number is a 1.
This means that $x(p-q)+(p-q)$ can be written as $x(p-q)+1(p-q)$.

Complete Exercise 1 number 2 on page 300.

TAKING OUT A MINUS

Illustrative Example 1: **Expand and simplify** $-(x-y)$.

$-(x-y) \rightarrow$ distribute the '–' into the brackets

$=-x+y$

$=y-x$

Illustrative Example 2: **Expand and simplify** $-(b-a)$.

$-(b-a) \rightarrow$ distribute the '–' into the brackets

$=-b+a$

$=a-b$

From the above examples, it can be seen that **distributing a minus** into a bracket **changes the sign of every term** in the bracket.

When factorising you can take a minus out and change the sign of every term in the bracket.
In other words $(b-a)=-(-b+a)=-(a-b)$.
This is usually done to create a HCF as shown in example 1 below.

Example 1: **Factorise** $x(a-b)+2(b-a)$

$x(a-b)+2(b-a) \rightarrow$ these brackets are actually the same, you have to take out a '–'

$=x(a-b)-2(a-b) \rightarrow$ a '+' × '–' is a '–', the sign of each term in the bracket changes

$=(a-b)(x-2) \rightarrow a-b$ was taken out as a HCF

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Example 2: **Factorise** $3x(p-q)-6(q-p)$

$3x(p-q)-6(q-p) \rightarrow$ these brackets are actually the same, you have to take out a '−'

$=3x(p-q)+6(p-q) \rightarrow$ a '−' × '−' is a '+', the sign of each term in the bracket changes

$=(p-q)(3x+6) \rightarrow$ 3 can still be taken out as a HCF

$=3(p-q)(x+2) \rightarrow$ this is the same as writing $(p-q)(3)(x+2)$

> **In the above example, you can take out the bracket of $(p-q)$ and 3 as a HCF in one step. In other words, the example could have been written as:**
>
> $3x(p-q)-6(q-p)$
>
> $=3x(p-q)+6(p-q)$
>
> $=3(p-q)(x+2)$

Example 3: **Factorise** $2x(3p-2q)-8(2q-3p)$

$2x(3p-2q)-8(2q-3p) \rightarrow$ take out a '−' to make a common bracket

$=2x(3p-2q)+8(3p-2q) \rightarrow$ a '−' × '−' is a '+', change the sign of each term

$=2(3p-2q)(x+4) \rightarrow$ 2 was taken out as a HCF, 2 is the HCF of $2x$ and 8

Example 4: **Factorise** $25x(a-b)+5(b-a)$

$25x(a-b)+5(b-a) \rightarrow$ take out a '−' to make a common bracket

$=25x(a-b)-5(a-b) \rightarrow$ a '−' × '+' is a '−', change the sign of each term

$=5(a-b)(5x-1) \rightarrow$ 5 was taken out as a HCF, 5 is the HCF of $25x$ and 5

Example 5: **Factorise** $9x^2(m-n)+3x(n-m)$

$9x^2(m-n)+3x(n-m) \rightarrow$ take out a '−' to make a common bracket

$=9x^2(m-n)-3x(m-n) \rightarrow$ a '−' × '+' is a '−', change the sign of each term

$=3x(m-n)(3x-1) \rightarrow$ $3x$ was taken out as a HCF, $3x$ is the HCF of $9x^2$ and $3x$

Example 6: **Factorise** $12x^2y(a-b)+8xy^2(b-a)$

$12x^2y(a-b)+8xy^2(b-a) \rightarrow$ take out a '−' to make a common bracket

$=12x^2y(a-b)-8xy^2(a-b) \rightarrow$ a '−' × '+' is a '−', change the sign of each term

$=4xy(a-b)(3x-2y) \rightarrow$ $4xy$ was taken out as a HCF, $4xy$ is the HCF of $12x^2y$ and $8xy^2$

Complete Exercise 1 number 3 on page 300.

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B. FACTORISATION OF THE DIFFERENCE OF TWO SQUARES (DOTS)

On page 74 in Chapter 8 it was shown that $(x-y)(x+y)=x^2-y^2$.

When two binomials which are the same, but differ in sign are multiplied together, the product (answer) is the **difference of their squares (DOTS)**.

The **difference of two squares is factorised as follows:**

$$x^2-y^2=\left(\sqrt{x^2}-\sqrt{y^2}\right)\left(\sqrt{x^2}+\sqrt{y^2}\right)$$
$$=(x-y)(x+y)$$

Only factorise using DOTS if the squares are separated by a minus sign.

x^2+y^2 cannot be factorised as the squares are separated by a plus sign.

Example 1: Factorise x^2-4.

$x^2-4 \rightarrow$ DOTS

$=(x-2)(x+2)$

Example 2: Factorise x^2-9.

$x^2-9 \rightarrow$ DOTS

$=(x-3)(x+3)$

Example 3: Factorise $4x^2-100$.

$=4\left(x^2-25\right) \rightarrow$ always take out a HCF first if possible

$=4\left(x^2-25\right) \rightarrow$ DOTS

$=4(x-5)(x+5)$

Example 4: Factorise x^2-49y^2.

$x^2-49y^2 \rightarrow$ DOTS

$=(x-7y)(x+7y)$

Example 5: Factorise $81x^2-121y^2$.

$81x^2-121y^2 \rightarrow$ DOTS

$=(9x-11y)(9x+11y)$

Example 6: Factorise x^2y^4-25.

$x^2y^4-25 \rightarrow$ DOTS

$=\left(xy^2-5\right)\left(xy^2+5\right)$

Note that the order of the brackets does not matter.
$(x-y)(x+y)$ is the same as $(x+y)(x-y)$.

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Example 7: **Factorise** $x^2-\frac{1}{9}$.

$x^2-\frac{1}{9} \rightarrow$ DOTS

$=\left(x-\frac{1}{3}\right)\left(x+\frac{1}{3}\right)$

Example 8: **Factorise** $\frac{x^2}{16}-\frac{1}{64}$.

$\frac{x^2}{16}-\frac{1}{64} \rightarrow$ always take out a HCF first if possible, HCF $=\frac{1}{16}$

$=\frac{1}{16}\left(x^2-\frac{1}{4}\right) \rightarrow$ DOTS

$=\frac{1}{16}\left(x-\frac{1}{2}\right)\left(x+\frac{1}{2}\right)$

Example 9: **Factorise** $(x+1)^2-9$.

$(x+1)^2-9 \rightarrow$ DOTS, $(x+1)^2$ is a perfect square

$=[(x+1)-3][(x+1)+3] \rightarrow \sqrt{(x+1)^2}=(x+1)$

$=(x+1-3)(x+1+3)$

$=(x-2)(x+4)$

Example 10: **Factorise** $(x-2)^2-16$.

$(x-2)^2-16 \rightarrow$ DOTS, $(x-2)^2$ is a perfect square

$=[(x-2)-4][(x-2)+4] \rightarrow \sqrt{(x-2)^2}=(x-2)$

$=(x-2-4)(x-2+4)$

$=(x-6)(x+2)$

Example 11: **Factorise** $9(x-4)^2-16$.

$9(x-4)^2-16 \rightarrow$ DOTS, $9(x-4)^2$ is a perfect square

$=[3(x-4)-4][3(x-4)+4] \rightarrow \sqrt{9(x-4)^2}=3(x-4)$

$=(3x-12-4)(3x-12+4) \rightarrow 3(x-4)=3x-12$

$=(3x-16)(3x-8)$

Complete Exercise 2 number 1 on page 300.

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TAKING OUT A HCF WITH DIFFERENCE OF SQUARES

The first step in any factorisation problem is to take out a HCF if possible.

Example 1: **Factorise $2x^2 - 8$.**

$2x^2 - 8 \rightarrow$ 2 is the HCF of 2 and 8

$= 2\left(x^2 - 4\right) \rightarrow$ DOTS

$= 2(x-2)(x+2)$

Example 2: **Expand and simplify $7x^3 - 63x$.**

$7x^3 - 63x \rightarrow$ 7 is the HCF of 7 and 63, x is the HCF of x and x^3

$= 7x\left(x^2 - 9\right) \rightarrow$ DOTS

$= 7x(x-3)(x+3)$

Example 3: **Expand and simplify $10a^2b - 1000b$.**

$10a^2b - 1000b \rightarrow$ 10 is the HCF of 10 and 1000, b is the HCF of a^2b and b^3

$= 10b\left(a^2 - 100\right) \rightarrow$ DOTS

$= 10b(a-10)(a+10)$

DIFFERENCE OF SQUARES WHICH FACTORISE FURTHER

Example 1: **Factorise $x^4 - 16$.**

$x^4 - 16 \rightarrow$ DOTS

$= \left(x^2 - 4\right)\left(x^2 + 4\right) \rightarrow$ DOTS again factorise further, $x^2 + 4$ cannot factorise further

$= (x-2)(x+2)\left(x^2 + 4\right)$

Example 2: **Factorise $x^8 - 256$.**

$x^8 - 256 \rightarrow$ DOTS

$= \left(x^4 - 16\right)\left(x^4 + 16\right) \rightarrow$ DOTS again factorise further, $x^4 + 16$ cannot factorise further

$= \left(x^2 - 4\right)\left(x^2 + 4\right)\left(x^4 + 16\right) \rightarrow$ DOTS again factorise further, $x^2 + 4$ cannot factorise

$= (x-2)(x+2)\left(x^2 + 4\right)\left(x^4 + 16\right)$

Complete Exercise 2 number 2 on page 300.

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C. FACTORISATION OF TRINOMIALS

In Grade 9, the general form of a quadratic trinomial is $x^2 \pm bx \pm c$. There are two types of quadratic trinomials that you will be expected to factorise:

1. **A quadratic trinomial in the form of $x^2 \pm bx + c$.**
2. **A quadratic trinomial in the form of $x^2 \pm bx - c$.**

Quadratic trinomials factorise into the product of two binomials.

1. Factorising Trinomials in the Form of $x^2 \pm bx + c$

$x^2 \pm bx + c$

→ if the sign before the constant is a '+' then you know both signs in the brackets will be the same

→ both signs in the brackets will be the same as the sign before the coefficient of x

Illustrative Example 1: **Factorise $x^2 + 7x + 6$.**

$x^2 + 7x + 6$

Both signs in the brackets will be the same because the sign of the constant is positive.

Both signs will be a '+' as the coefficient of x is positive.

$(x + \square)(x + \square)$

In order to find the missing numbers you look at the factors of the constant (6).

The factors of 6 that can be added together that will result in the coefficient of x $(+7)$ will be the correct factors.

Factors of 6 are: $\begin{matrix} 3 \\ 2 \end{matrix}$; $\boxed{\begin{matrix} 6 \\ 1 \end{matrix}} \rightarrow 6 + 1 = 7$

$\therefore x^2 + 7x + 6 = (x + 6)(x + 1) \rightarrow$ this could also be written as $(x + 1)(x + 6)$

Illustrative Example 2: **Factorise $x^2 - 7x + 12$.**

$x^2 - 7x + 12$

You know both signs will be the same as the sign of the constant is positive.

You know both signs will be a '$-$' as the coefficient of x is negative.

$(x - \square)(x - \square)$

In order to find the missing numbers you look at the factors of the constant (12).

The factors of 12 that can be added together, that will result in the coefficient of x (-7), will be the correct factors.

Factors of 12 are: $\begin{matrix} 12 \\ 1 \end{matrix}$ $\begin{matrix} 6 \\ 2 \end{matrix}$ $\boxed{\begin{matrix} 4 \\ 3 \end{matrix}} \rightarrow -4 - 3 = -7$

$\therefore x^2 - 7x + 12 = (x - 4)(x - 3) \rightarrow$ this could also be written as $(x - 3)(x - 4)$

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Example 1: Factorise $x^2 - 9x + 20$.

$x^2 - 9x + 20 \rightarrow$ both signs in the bracket are the same, both signs are '−'

$= (x-5)(x-4) \rightarrow$ factors of 20: $\begin{matrix} 20 & 10 & \boxed{5} \\ 1 & 2 & \boxed{4} \end{matrix} \rightarrow -5-4=-9$

Example 2: Factorise $x^2 + 11x + 24$.

$x^2 + 11x + 24 \rightarrow$ both signs in the bracket are the same, both signs are '+'

$= (x+8)(x+3) \rightarrow$ factors of 24: $\begin{matrix} 24 & 12 & 6 & \boxed{8} \\ 1 & 2 & 4 & \boxed{3} \end{matrix} \rightarrow 8+3=11$

Example 3: Factorise $2x^2 + 16x + 30$.

$2x^2 + 16x + 30 \rightarrow$ always look for a HCF first (2 is common to all the terms)

$= 2\left(x^2 + 8x + 15\right) \rightarrow$ both signs in the bracket are the same, both signs are '+'

$= 2(x+5)(x+3) \rightarrow$ factors of 15: $\begin{matrix} 15 & \boxed{5} \\ 1 & \boxed{3} \end{matrix} \rightarrow 5+3=8$

Example 4: Factorise $3x^2 - 45x + 168$.

$3x^2 - 45x + 168 \rightarrow$ always look for a HCF first (3 is common to all the terms)

$= 3\left(x^2 - 15x + 56\right) \rightarrow$ both signs in the bracket are the same, both signs are '−'

$= 3(x-7)(x-8) \rightarrow$ factors of 56: $\begin{matrix} 1 & 2 & 4 & \boxed{7} \\ 56 & 28 & 14 & \boxed{8} \end{matrix} \rightarrow -7-8=-15$

Example 5: Factorise $2x^2 + 16x + 32$.

$2x^2 + 16x + 32 \rightarrow$ always look for a HCF (2 is common to all the terms)

$= 2\left(x^2 + 8x + 16\right) \rightarrow$ both signs in the bracket are the same, both signs are '+'

$= 2(x+4)(x+4) \rightarrow$ factors of 1: $\begin{matrix} 16 & 8 & \boxed{4} \\ 1 & 2 & \boxed{4} \end{matrix} \rightarrow 4+4=8$

$= 2(x+4)^2$

When factorising, always look for a Highest Common Factor (HCF) first (pg. 79).

Complete Exercise 3 number 1 on page 300.

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2. Factorising Trinomials in the Form of $x^2 \pm bx - c$

$x^2 \pm bx - c$

- if the sign before the constant is a '−' then you know there will be opposite signs in the brackets
- the larger of the two factors will get the sign before the coefficient of x

<u>Illustrative Example 1</u>: Factorise $x^2 + 5x - 6$

$x^2 + 5x - 6$

You know the signs in the brackets will be opposite as the sign of the constant is negative.

You know the larger factor will get a '+' as the coefficient of x is positive.

$(x - \square)(x + \square)$

In order to find the missing numbers you look at the factors of the constant (6).

The correct factors will be the factors of 6, where the **difference** between the factors will result in the coefficient of x $(+5)$.

Factors of 6 are:		
3	**6**	$\rightarrow 6 - 1 = 5$
2	**1**	

$x^2 + 5x - 6 = (x - 1)(x + 6) \rightarrow$ 6 is the larger factor, $\therefore$ the 6 gets the '+'

In the above example, if 3 and 2 are added together the answer is 5. It would be incorrect to use these factors as both terms have to be added together to obtain an answer of 5. As the constant term is negative, one factor has to be positive and the other has to be negative.

<u>Illustrative Example 2</u>: Factorise $x^2 - 11x - 12$

$x^2 - 11x - 12$

You know the signs in the brackets will be opposite as the sign of the constant is negative.

You know the larger factor will get a '−' as the coefficient of x is negative.

$(x - \square)(x + \square)$

In order to find the missing numbers you look at the factors of the constant (12).

The correct factors will be the factors of 12, where the **difference** between the factors will result in the coefficient of x (11).

Factors of 12 are:		
6	**12**	$\rightarrow -12 + 1 = -11$
2	**1**	

$x^2 - 11x - 12 = (x - 12)(x + 1) \rightarrow$ 12 is the larger factor, $\therefore$ the 12 gets the '−'

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Example 1: Factorise $x^2 + 2x - 8$

$x^2 + 2x - 8 \rightarrow$ opposite signs in the brackets, the larger factor gets a '+'

factors of 8: $\begin{matrix} 8 & \boxed{4} \\ 1 & \boxed{2} \end{matrix} \rightarrow 4 - 2 = 2$

$= (x - 2)(x + 4) \rightarrow$ 4 is the larger factor, $\therefore$ the 4 gets the '+'

Example 2: Factorise $x^2 - 4x - 12$

$x^2 - 4x - 12 \rightarrow$ opposite signs in the brackets, the larger factor gets a '−'

factors of 12: $\begin{matrix} 12 & 4 & \boxed{6} \\ 1 & 3 & \boxed{2} \end{matrix} \rightarrow -6 + 2 = -4$

$= (x - 6)(x + 2) \rightarrow$ 6 is the larger factor, $\therefore$ the 6 gets the '−'

Example 3: Factorise $2x^2 + 10x - 28$

$2x^2 + 10x - 28 \rightarrow$ always look for a common factor first (2 is common to all the terms)

$= 2\left(x^2 + 5x - 14\right) \rightarrow$ opposite signs in the brackets, the larger factor gets a '+'

factors of 14: $\begin{matrix} 14 & \boxed{7} \\ 1 & \boxed{2} \end{matrix} \rightarrow 7 - 2 = 5$

$= 2(x + 7)(x - 2) \rightarrow$ 7 is the larger factor, $\therefore$ the 7 gets the '+'

Example 4: Factorise $6x^2 + 12x - 18$

$6x^2 + 12x - 18 \rightarrow$ always look for a common factor first (6 is common to all the terms)

$= 6\left(x^2 + 2x - 3\right) \rightarrow$ opposite signs in the brackets, the larger factor gets a '+'

factors of 3: $\begin{matrix} \boxed{3} \\ \boxed{1} \end{matrix} \rightarrow 3 - 1 = 2$

$= 6(x + 3)(x - 1) \rightarrow$ 3 is the larger factor, $\therefore$ the 3 gets the '+'

Example 5: Factorise $5x^2 + 10x - 15$

$5x^2 + 10x - 15 \rightarrow$ always look for a common factor first (5 is common to all the terms)

$= 5\left(x^2 + 2x - 3\right) \rightarrow$ opposite signs in the brackets, the larger factor gets a '+'

factors of 3: $\begin{matrix} \boxed{3} \\ \boxed{1} \end{matrix} \rightarrow 3 - 1 = 2$

$= 5(x + 3)(x - 1) \rightarrow$ 2 is the larger factor, $\therefore$ the 3 gets the '+'

Complete Exercise 3 number 2 and 3 on page 301 .

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D. SIMPLIFYING ALGEBRAIC EXPRESSIONS

To simplify algebraic fractions, you will often have to factorise first.

Example 1: **Simplify** $\dfrac{8x^2-4}{4}$.

$\dfrac{8x^2-4}{4} \rightarrow$ take out a HCF of 4, do not cancel over a '+' or '−' sign

$= \dfrac{\cancel{4}\left(2x^2-1\right)}{\cancel{4}} \rightarrow$ now you can cancel the 4

$= 2x^2-1$

You can never cancel over a plus or minus sign. The example below is incorrect:

$$\frac{3x+6}{6}$$
$$\neq \frac{3x+\cancel{6}}{\cancel{6}}$$
$$\neq 3x+1$$

When simplified correctly a HCF of 3 is taken out of the numerator (top).

$$\frac{3x+6}{6}$$
$$= \frac{3(x+2)}{6}$$
$$= \frac{\cancel{3}(x+2)}{\cancel{6}^{2}}$$
$$= \frac{x+2}{2}$$

Example 2: **Simplify** $\dfrac{5pq+p}{pq}$.

$\dfrac{5pq+p}{pq} \rightarrow$ take out a HCF of p, do not cancel over a '+' or '−' sign

$= \dfrac{\cancel{p}(5q+1)}{\cancel{p}q} \rightarrow$ now you can cancel

$= \dfrac{5q+1}{q}$

In this section, you may assume that all denominators are not equal to zero.

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Example 3: **Simplify** $\dfrac{5xy-10xy^2}{15xy}$.

$\dfrac{5xy-10xy^2}{15xy} \rightarrow$ take out a HCF of $5xy$, do not cancel over a '+' or '−' sign

$= \dfrac{\cancel{5}\,\cancel{xy}(1-2y)}{\cancel{15}^3\,\cancel{xy}} \rightarrow$ now you can cancel

$= \dfrac{1-2y}{3}$

Example 4: **Simplify** $\dfrac{8m^2n-12mn^2}{4m^2n^2}$.

$\dfrac{8m^2n-12mn^2}{4m^2n^2} \rightarrow$ take out a HCF of $4mn$, do not cancel over a '+' or '−' sign

$= \dfrac{\cancel{4}\,mn(2m-3n)}{\cancel{4}\,m^{\cancel{2}1}n^{\cancel{2}1}} \rightarrow$ now you can cancel

$= \dfrac{2m-3n}{mn}$

Example 5: **Simplify** $\dfrac{21x^2y^4-14xy}{14xy+7xyz}$.

$\dfrac{21x^2y^4-14xy}{14xy+7xyz} \rightarrow$ take out a HCF of $7xy$ from the top(numerator) and bottom(denominator)

$= \dfrac{\cancel{7xy}\left(3xy^3-2\right)}{\cancel{7xy}\,(2+z)} \rightarrow$ now you can cancel

$= \dfrac{3xy^3-2}{2+z}$

Example 6: **Simplify** $\dfrac{3a^4b^4-3a^2b^5}{6a^3b^4}$.

$\dfrac{3a^4b^4-3a^2b^5}{6a^3b^4} \rightarrow$ take out a HCF of $3a^2b^4$, do not cancel over a '+' or '−' sign

$= \dfrac{\cancel{3}\,\cancel{a^2}^1\,\cancel{b^4}\left(a^2-b\right)}{\cancel{6}^2\,a^{\cancel{3}1}\,\cancel{b^4}} \rightarrow$ now you can cancel

$= \dfrac{a^2-b}{2a}$

Complete Exercise 4 number 1 on page 301.

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Example 7: **Simplify** $\dfrac{x^2-4}{x+2}$.

$\dfrac{x^2-4}{x+2}$ → factorise the top (numerator) using the difference of squares

$=\dfrac{(x-2)\cancel{(x+2)}}{\cancel{x+2}}$

$=x-2$

Example 8: **Simplify** $\dfrac{x^2+2x-15}{x-3}\div\dfrac{x+5}{x}$.

$\dfrac{x^2+2x-15}{x-3}\div\dfrac{x+5}{x}$ → tip and times

$=\dfrac{x^2+2x-15}{x-3}\times\dfrac{x}{x+5}$ → factorise before simplifying (or multiplying)

$=\dfrac{\cancel{(x-3)}\cancel{(x+5)}}{\cancel{x-3}}\times\dfrac{x}{\cancel{x+5}}$

$=x$

Example 9: **Simplify** $\dfrac{x^2+5x-14}{x-3}\times\dfrac{x^2+x-12}{2-x}\times\dfrac{1}{x^2+4x}$.

$\dfrac{x^2+5x-14}{x-3}\times\dfrac{x^2+x-12}{2-x}\times\dfrac{1}{x^2+4x}$ → factorise before simplifying (or multiplying)

$=\dfrac{(x+7)(x-2)}{\cancel{x-3}}\times\dfrac{\cancel{(x-3)}\cancel{(x+4)}}{2-x}\times\dfrac{1}{x\cancel{(x+4)}}$

$=\dfrac{(x+7)(x-2)}{1}\times\dfrac{1}{2-x}\times\dfrac{1}{x}$ → take out a '−'

$=\dfrac{(x+7)\cancel{(x-2)}}{1}\times\dfrac{1}{-\cancel{(x-2)}}\times\dfrac{1}{x}$

$=\dfrac{x+7}{-x}$ → this is the same as $\dfrac{-(x+7)}{x}$ or $-\dfrac{x+7}{x}$

Example 10: **Simplify** $\dfrac{x^2-9}{x^2+x-6}\div\dfrac{x^2-x-6}{x^2-4}$.

$\dfrac{x^2-9}{x^2+x-6}\div\dfrac{x^2-x-6}{x^2-4}$ → tip and times

$=\dfrac{x^2-9}{x^2+x-6}\times\dfrac{x^2-4}{x^2-x-6}$ → factorise before simplifying (or multiplying)

$=\dfrac{\cancel{(x-3)}\cancel{(x+3)}}{\cancel{(x+3)}\cancel{(x-2)}}\times\dfrac{\cancel{(x+2)}\cancel{(x-2)}}{\cancel{(x+2)}\cancel{(x-3)}}$

$=1$

Complete Exercise 4 number 2 on page 301 and The Mixed Exercise on pages 301 and 302.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to …
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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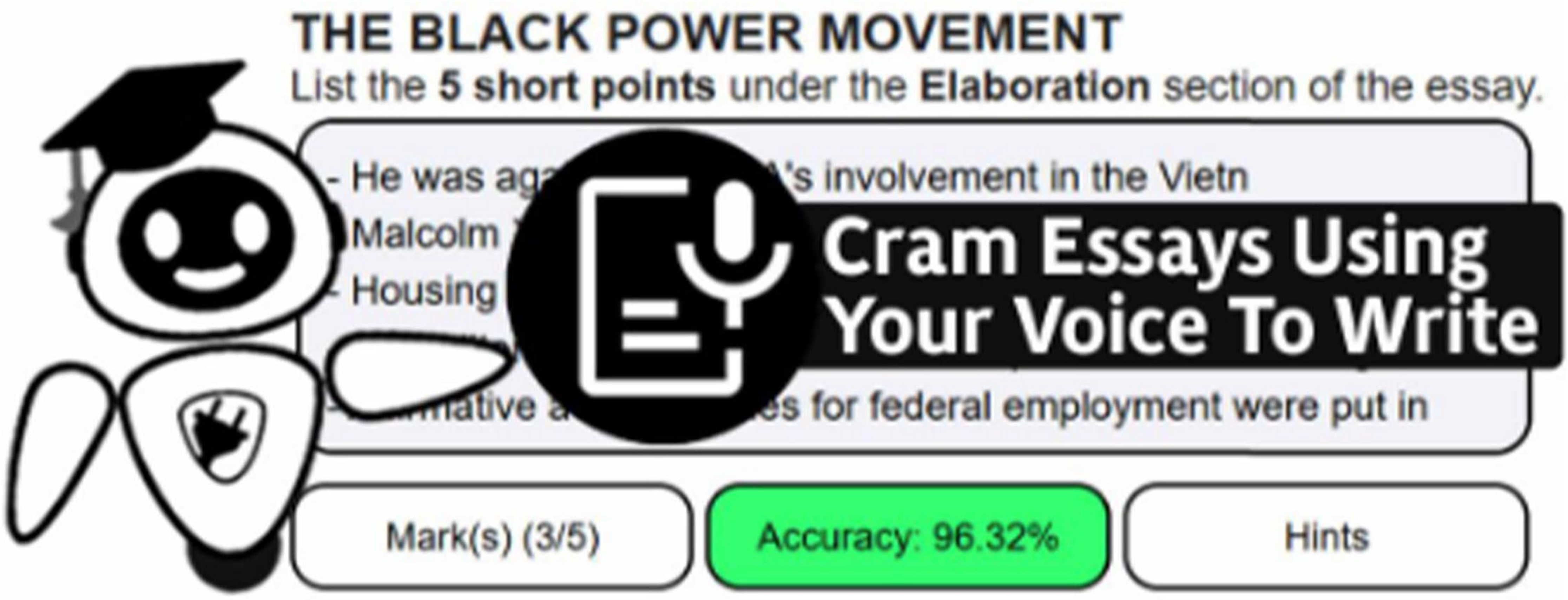

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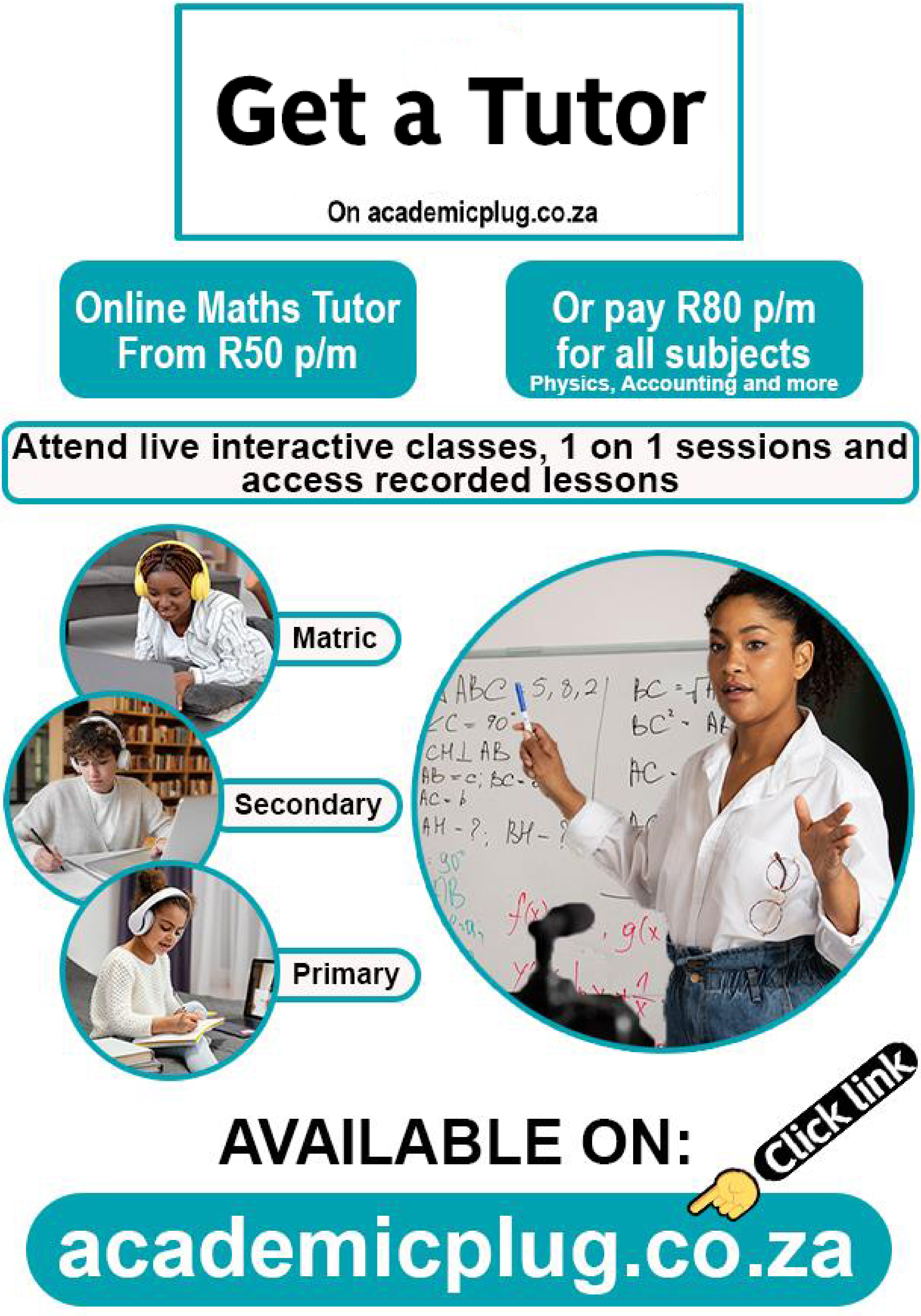

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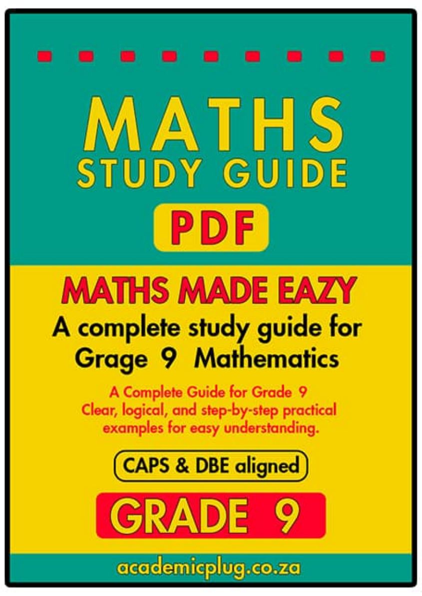

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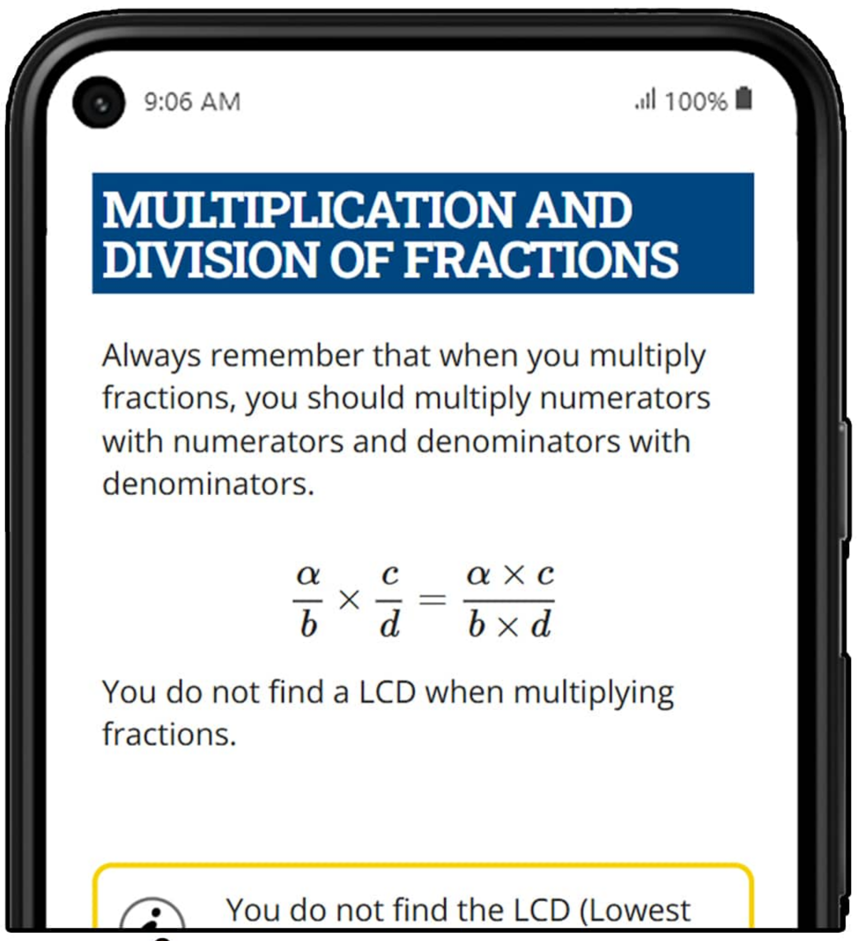

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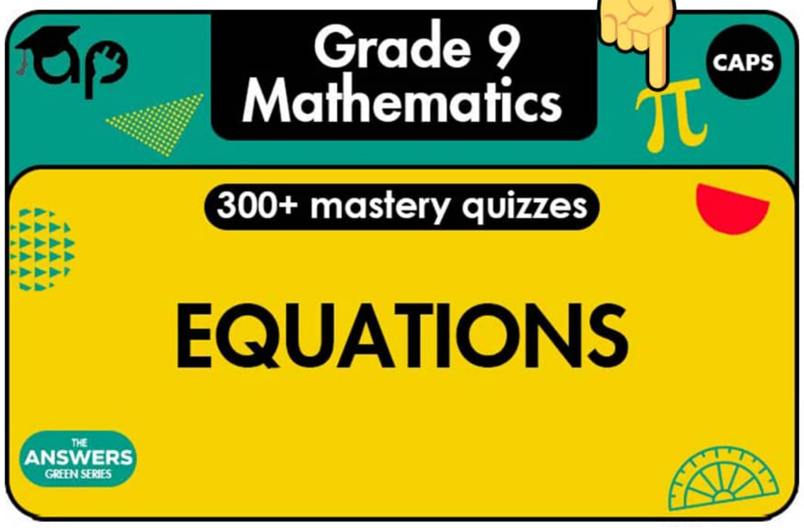

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CHAPTER 10 – EQUATIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
93	**A. Grade 8 revision**	**2.4**	• Set up equations to describe problem situations • Analyse and interpret equations that describe a given situation • Solve equations by inspection, using additive and multiplicative inverses and using the laws of exponents • Determine the numerical value of an expression by substitution • Solve equations using factorisation
93	• Solving Equations Using Additive Inverses		
93	• Shortcut to Solving Equations		
94	• Solving Equations Using the Multiplicative Inverse		
95	**B. Solving Equations with Fractions**		
97	• Equations with Variable Denominators		
98	**C. Quadratic Equations**		
99	• Steps to Solving Quadratic Equations		
101	• Shortcut to Solving Equations with Brackets		
102	**D. Mathematical Modelling (Word Problems)**		
102	• Steps to Solving Word Problems		

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A. GRADE 8 REVISION

SOLVING EQUATIONS USING ADDITIVE INVERSES

<u>Example 1</u>: Determine the value of *x* if $x - 7 = 3$.

$x - 7 = 3 \rightarrow$ add 7 to both sides in order to get x on its own

$\therefore x - 7 + 7 = 3 + 7$

$\therefore x + 0 = 10 \rightarrow$ you do not have to show this step

$\therefore x = 10$

<u>Example 2</u>: Determine the value of *x* if $x + 8 = 12$.

$x + 8 = 12 \rightarrow$ subtract 8 from both sides in order to get x on its own

$\therefore x + 8 - 8 = 12 - 8$

$\therefore x + 0 = 4 \rightarrow$ you do not have to show this step

$\therefore x = 4$

Whatever is done to one side of an equation has to be done to the other side of the equation.

SHORTCUT TO SOLVING EQUATIONS

When solving equations, a shortcut to is to **change the sign** of numbers and variables **when 'moving them over' the equals sign**. Examine the equation $x + 2 = 5$. In order to solve for x we 'move the +2 over the equal sign'. When taking numbers over the equal sign their sign changes.

when taking the 2 over the equal sign, change it to –2

$$x + 2 = 5$$
$$\therefore x = 5 - 2$$
$$\therefore x = 3$$

<u>Example 1</u>: Determine the value of *x* if $8x - 6 = -8 + 7x$.

$8x - 6 = -8 + 7x \rightarrow$ move $7x$ to the LHS and the -6 to the RHS

$\therefore 8x - 7x = -8 + 6 \rightarrow$ the signs changed when moving to the other side

$\therefore x = -2$

When solving equations always move all variables to one side of the equation and numbers to the other side of the equation.

<u>Example 2</u>: Determine the value of *a* if $17a + 8 = 12 + 16a$.

$17a + 8 = 12 + 16a \rightarrow$ move $16a$ to the LHS and the $+8$ to the RHS

$\therefore 17a - 16a = 12 - 8 \rightarrow$ the signs changed when moving to the other side

$\therefore a = 4$

When solving equations the layout used is very important.
You cannot have two equal signs in one line. The LHS of the equation must have a therefore (∴) sign. The therefore sign can be omitted but it cannot be replaced with an equal sign.

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SOLVING EQUATIONS USING THE MULTIPLICATIVE INVERSE

Example 1: Determine the value of x if $18x - 7x = 16 + 6$.

$18x - 7x = 16 + 6$

$\therefore 11x = 22 \rightarrow$ divide both sides by 11

$\therefore \frac{\cancel{11}x}{\cancel{11}} = \frac{22}{11}$

$\therefore x = 2$

Example 2: Determine the value of x if $12x - 8 = 20 + 10x$.

$12x - 8 = 20 + 10x \rightarrow$ move $10x$ to the LHS and the -8 to the RHS

$\therefore 12x - 10x = 20 + 8 \rightarrow$ the signs changed when moving to the other side

$\therefore 2x = 28 \rightarrow$ divide both sides by 2

$\therefore \frac{\cancel{2}x}{2} = \frac{28}{2}$

$\therefore x = 14$

Example 3: Determine the value of x if $6(3x - 2) = 7(x + 3) + 2$.

$6(3x - 2) = 7(x + 3) + 2 \rightarrow$ distribute the 6 and 7

$\therefore 18x - 12 = 7x + 21 + 2 \rightarrow$ take the variables to one side and numbers to the other

$\therefore 18x - 7x = 21 + 2 + 12$

$\therefore 11x = 35 \rightarrow$ divide both sides by 11

$\frac{\cancel{11}x}{\cancel{11}} = \frac{35}{11}$

$\therefore x = \frac{35}{11}$

When solving equations, you will often get answers which are fractions.

Example 4: Determine the value of x if $3(7x - 4) = 9$.

Method 1: First distribute the 3

$3(7x - 4) = 9 \rightarrow$ distribute the 3

$\therefore 21x - 12 = 9 \rightarrow$ take the -12 to the RHS

$\therefore 21x = 21 \rightarrow$ divide both sides by 21

$\therefore \frac{\cancel{21}x}{\cancel{21}} = \frac{21}{21}$

$\therefore x = 1$

Method 2: First divide both sides by 3

$3(7x - 4) = 9 \rightarrow$ divide both sides by 3

$\therefore \frac{\cancel{3}(7x - 4)}{\cancel{3}} = \frac{9}{3}$

$\therefore 7x - 4 = 3 \rightarrow$ take the -4 to the RHS

$\therefore 7x = 7 \rightarrow$ divide both sides by 7

$\therefore \frac{\cancel{7}x}{\cancel{7}} = \frac{7}{7}$

$\therefore x = 1$

Complete Exercise 1 on page 309.

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B. SOLVING EQUATIONS WITH FRACTIONS

Examples 1 through to 3 are Grade 8 revision of simple equations with fractions.

<u>Example 1</u>: Determine the value of x if $\dfrac{5x-10}{3}=7$.

$\dfrac{5x-10}{3}=7 \rightarrow$ multiply both sides by 3

$\therefore \dfrac{5x-10}{\cancel{3}}\times\cancel{3}=7\times 3$

$\therefore 5x-10=21 \rightarrow$ take the -10 to the RHS

$\therefore 5x=31$

$\therefore \dfrac{\cancel{5}x}{\cancel{5}}=\dfrac{31}{5}$

$\therefore x=\dfrac{31}{5}$

<u>Example 2</u>: Determine the value of x if $\dfrac{2}{5}x+3=9$:

$\dfrac{2x}{5}+3=9 \rightarrow$ move the 3 to the RHS, $\dfrac{2}{5}x$ is the same as $\dfrac{2x}{5}$

$\therefore \dfrac{2x}{5}=6 \rightarrow$ multiply both sides by 5

$\therefore \dfrac{2x}{\cancel{5}}\times\cancel{5}=6\times 5$

$\therefore 2x=30 \rightarrow$ divide both sides by 2

$\therefore \dfrac{\cancel{2}x}{\cancel{2}}=\dfrac{30}{2}$

$\therefore x=15$

It is important to remember that a number like $\dfrac{x}{3}$ is the same as $\dfrac{1}{3}\times x$.

<u>Example 3</u>: Determine the value of x if $\dfrac{10}{x}+3=8$.

$\dfrac{10}{x}+3=8 \rightarrow$ first take 3 over to the RHS

$\therefore \dfrac{10}{x}=5 \rightarrow$ now multiply both sides by x

$\therefore \dfrac{10}{\cancel{x}}\times\cancel{x}=5\times x$

$\therefore 10=5x \rightarrow$ divide both sides by 5

$\therefore \dfrac{10}{5}=\dfrac{\cancel{5}x}{\cancel{5}}$

$\therefore 2=x \rightarrow$ you may leave your answer like this, you don't have to write x on the LHS

$\therefore x=2$

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When dealing with more complicated fractions in Grade 9, you need to **determine an LCD for both sides of the equation** and **then multiply both sides** of the equation **by the LCD**. This is often called 'dropping the LCD'.

Example 4: Determine the value of a if $\frac{a+5}{3}-\frac{a+1}{6}=\frac{a}{3}-2$.

$\frac{a+5}{3}-\frac{a+1}{6}=\frac{a}{3}-2 \rightarrow \text{LCD}=6$

$\therefore \frac{2(a+5)-(a+1)}{6}=\frac{2a-6(2)}{6} \rightarrow$ multiply both sides by 6, you don't have to show this

$\therefore \frac{2(a+5)-(a+1)}{\cancel{6}}\times\frac{\cancel{6}}{1}=\frac{2a-6(2)}{\cancel{6}}\times\frac{\cancel{6}}{1} \rightarrow$ you don't have to show this step

$\therefore 2(a+5)-(a+1)=2a-6(2)$

$\therefore 2a+10-a-1=2a-12 \rightarrow$ take all the numbers to one side and the variables to the other

$\therefore 2a-a-2a=-12-10+1$

$\therefore -a=-21 \rightarrow$ multiply both sides by -1

$\therefore a=21$

When dealing with equations with fractions, you do not have to show the steps of finding an LCD. You merely have to multiply both sides of the equation by the LCD. This is known as 'dropping the denominator'. You can only do this with equations. You can never drop the LCD when simplifying algebraic fractions.

Example 5: Determine the value of x if $\frac{2x+6}{2}-\frac{2x-4}{3}=2x-4$.

$\frac{2x+6}{2}-\frac{2x-4}{3}=2x-4 \rightarrow \text{LCD}=6$

$\therefore \frac{3(2x+6)-2(2x-4)}{6}=\frac{6(2x-4)}{6} \rightarrow$ multiply both sides by 6

$\therefore 6x+18-4x+8=12x-24 \rightarrow$ both sides were multiplied by 6, the LCD was 'dropped'

$\therefore 6x-4x-12x=-24-18-8$

$\therefore -10x=-50 \rightarrow$ divide both sides by -10

$\therefore x=5$

Example 6: Determine the value of k if $\frac{7k+3}{5}+\frac{3k-8}{10}=2k-\frac{4}{2}$.

$\frac{7k+3}{5}+\frac{3k-8}{10}=2k-\frac{4}{2} \rightarrow \text{LCD}=10$

$\therefore \frac{2(7k+3)+(3k-8)}{10}=\frac{10(2k)-5(4)}{10} \rightarrow$ multiply both sides by 10

$\therefore 14k+6+3k-8=20k-20 \rightarrow$ both sides were multiplied by 10, the LCD was 'dropped'

$\therefore 14k+3k-20k=-20-6+8$

$\therefore -3k=-18 \rightarrow$ divide both sides by -3

$\therefore k=6$

Complete Exercise 2 number 1 and 2 on page 309.

EQUATIONS WITH VARIABLE DENOMINATORS

When dealing with fractions **the denominator cannot be equal to 0**.
If there is a **variable** (such as x) **in the denominator** you have to **place a restriction on the variable so that the denominator does not equal 0**.

Example 1: Determine the value of x if $3-\frac{1}{x}=\frac{5}{x}+\frac{3}{2}$.

$3-\frac{1}{x}=\frac{5}{x}+\frac{3}{2} \rightarrow \text{LCD}=2x,\ 2x \neq 0 \rightarrow \therefore x \neq 0,$ you have to put in this restriction

$\therefore \frac{2x(3)-2(1)}{2x}=\frac{2(5)+x(3)}{2x} \rightarrow$ multiply both sides by $2x$

$\therefore 6x-2=10+3x \rightarrow$ both sides were multiplied by $2x$, the LCD was 'dropped'

$\therefore 6x-3x=10+2$

$\therefore 3x=12 \rightarrow$ divide both sides by 3

$\therefore x=4$

Example 2: Determine the value of x if $\frac{5}{x}+3=\frac{2x+5}{x}-7$.

$\frac{5}{x}+3=\frac{2x+5}{x}-7 \rightarrow \text{LCD}=x,\ x \neq 0 \rightarrow$ you have to put in this restriction

$\therefore \frac{5+x(3)}{x}=\frac{2x+5-x(7)}{x} \rightarrow$ multiply both sides by x

$\therefore 5+3x=2x+5-7x \rightarrow$ both sides were multiplied by x, the LCD was 'dropped'

$\therefore 3x-2x+7x=5-5$

$\therefore 8x=0 \rightarrow$ divide both sides by 8

$\therefore x=0$

but from the restriction above $x \neq 0$

$\therefore$ no solution

Example 3: Determine the value of x if $\frac{2(x+5)}{x}-\frac{3x+2}{x}=\frac{1}{2}+\frac{8}{x}$.

$\frac{2(x+5)}{x}-\frac{3x+2}{x}=\frac{1}{2}+\frac{8}{x}$

$\therefore \frac{2x+10}{x}-\frac{3x+2}{x}=\frac{1}{2}+\frac{8}{x} \rightarrow \text{LCD}=2x, \rightarrow x \neq 0,$ you have to put in this restriction

$\therefore \frac{2(2x+10)-2(3x+2)}{2x}=\frac{x(1)+2(8)}{2x} \rightarrow$ multiply both sides by $2x$

$\therefore 4x+20-6x-4=x+16 \rightarrow$ both sides were multiplied by $2x$, the LCD was 'dropped'

$\therefore 4x-6x-x=16-20+4$

$\therefore -3x=0 \rightarrow$ divide both sides by -3

$\therefore x=0$

but from the restriction above $x \neq 0$

$\therefore$ no solution

Complete Exercise 2 number 3 on page 309.

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C. QUADRATIC EQUATIONS

According to CAPS this section should be covered in Term 3. However, from practical experience, most teachers choose to cover quadratic equations after linear equations.

A **quadratic equation** is an equation in the **form of**:

$$ax^2 + bx + c = 0$$

Quadratic equations always have **2 solutions**.

It is important to understand that if $x \times y = 0$ then either, $x = 0$ or $y = 0$. This means that there are two solutions. $x = 0$ is one solution and $y = 0$ is another solution.

Illustrative Example: Determine the value of x if $(x-2)(x+1)=0$.

$\underbrace{(x-2)}_{0}\underbrace{(x+1)}_{0} = 0$

The only way that the above equation can be true is if either $x-2=0$ or $x+1=0$.

$\therefore x-2=0 \quad \text{or} \quad x+1=0$

$\therefore x=2 \quad \text{or} \quad x=-1$

Example 1: Determine the value of x if $(x-3)(x+4)=0$.

$(x-3)(x+4)=0 \rightarrow$ either $x-3=0$ or $x+4=0$

$\therefore x-3=0 \quad \text{or} \quad x+4=0$

$\therefore x=3 \quad \text{or} \quad x=-4$

Example 2: Determine the value of x if $(5x-6)(x+2)=0$.

$(5x-6)(x+2)=0 \rightarrow$ either $x-6=0$ or $x+2=0$

$\therefore 5x-6=0 \quad \text{or} \quad x+2=0$

$\therefore 5x=6 \quad \text{or} \quad x=-2 \rightarrow$ divide both sides of the equation by 5

$\therefore x=\frac{6}{5} \quad \text{or} \quad x=-2$

Example 3: Determine the value of x if $x(x-12)=0$.

$x(x-12)=0 \rightarrow$ either $x=0$ or $x-12=0$

$\therefore x=0 \quad \text{or} \quad x-12=0$

$\therefore x=0 \quad \text{or} \quad x=12$

It is important to note that if $(x-a)(x-b)=0$ then $x-a=0$ or $x-b=0$. However, if $(x-a)(x-b)=k$ where k is any number other than 0 then $x-a \neq k$ and $x-b \neq k$.

Complete Exercise 3 number 1 on page 309.

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STEPS TO SOLVING QUADRATIC EQUATIONS

1. RHS or LHS must be equal to zero.
2. Factorise (always look for a highest common factor first).
3. Solve for x.

Example 1: Determine the value of x if $x^2 + 3x = 0$.

$x^2 + 3x = 0 \rightarrow$ take out a HCF of x

$\therefore x(x+3) = 0 \rightarrow$ do not divide ('drop') the x as it is a variable

$\therefore x = 0$ or $x + 3 = 0$

$\therefore x = 0$ or $x = -3$

You can never divide both sides of an equation by a variable as the variable could be equal to 0.

Example 2: Determine the value of x if $5x^2 + 10x = 0$.

$5x^2 + 10x = 0 \rightarrow$ take out a HCF of $5x$

$\therefore 5x(x+2) = 0 \rightarrow$ divide both sides by 5 (do not divide by x)

$\therefore x(x+2) = 0 \rightarrow \frac{\cancel{5}x(x+2)}{\cancel{5}} = \frac{0}{5} \rightarrow \frac{0}{\text{any number}} = 0$

$\therefore x = 0$ or $x + 2 = 0$

$\therefore x = 0$ or $x = -2$

Example 3: Determine the value of x if $x^2 = 4$.

$x^2 = 4 \rightarrow$ move the 4 to the LHS (one side must equal 0)

$\therefore x^2 - 4 = 0 \rightarrow$ difference of squares, factorise

$\therefore (x-2)(x+2) = 0$

$\therefore x - 2 = 0$ or $x + 2 = 0$

$\therefore x = 2$ or $x = -2$

Example 4: Determine the value of x if $18x^2 = 8$.

$18x^2 = 8 \rightarrow$ move the 8 to the LHS (one side must equal 0)

$\therefore 18x^2 - 8 = 0 \rightarrow$ take out a HCF of 2

$\therefore 2(9x^2 - 4) = 0 \rightarrow$ divide both sides by 2 $\rightarrow \frac{\cancel{2}(9x^2 - 4)}{\cancel{2}} = \frac{0}{2} \rightarrow \frac{0}{\text{any number}} = 0$

$\therefore 9x^2 - 4 = 0 \rightarrow$ difference of squares, factorise

$\therefore (3x-2)(3x+2) = 0$

$\therefore 3x - 2 = 0$ or $3x + 2 = 0$

$\therefore 3x = 2$ or $3x = -2 \rightarrow$ divide both sides by 3

$\therefore x = \frac{2}{3}$ or $x = -\frac{2}{3}$

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Example 5: Determine the value of x if $x^2-5x+6=0$.

$x^2-5x+6=0 \rightarrow$ factorise

$\therefore (x-3)(x-2)=0$

$\therefore x-3=0$ or $x-2=0$

$\therefore x=3$ or $x=2$

Example 6: Determine the value of x if $x^2-3x+2=0$.

$x^2-3x+2=0 \rightarrow$ factorise

$\therefore (x-1)(x-2)=0$

$\therefore x-1=0$ or $x-2=0$

$\therefore x=1$ or $x=2$

Example 7: Determine the value of x if $x^2-7x=18$.

$x^2-7x=18 \rightarrow$ move the 18 to the LHS (one side must equal 0)

$\therefore x^2-7x-18=0 \rightarrow$ factorise

$\therefore (x-9)(x+2)=0$

$\therefore x-9=0$ or $x+2=0$

$\therefore x=9$ or $x=-2$

Example 8: Determine the value of x if $2x^2-30x-32=0$.

$2x^2-30x-32=0 \rightarrow$ take out a HCF of 2

$\therefore 2\left(x^2-15x-16\right)=0 \rightarrow$ divide both sides by 2

$\therefore x^2-15x-16=0 \rightarrow$ factorise

$\therefore (x-16)(x+1)=0$

$\therefore x-16=0$ or $x+1=0$

$\therefore x=16$ or $x=-1$

Example 9: Given the equation $3x^2+6x=45$:

a) Determine the possible values of x.
b) Check that your answers are correct.

a) $3x^2+6x=45 \rightarrow$ move the 45 to the LHS

$\therefore 3x^2+6x-45=0 \rightarrow$ take out a HCF of 3

$\therefore 3\left(x^2+2x-15\right)=0 \rightarrow$ divide both sides by 3

$\therefore x^2+2x-15=0 \rightarrow$ factorise

$(x+5)(x-3)=0$

$\therefore x+5=0$ or $x-3=0$

$\therefore x=-5$ or $x=3$

b) Check $x=-5$:

Substitute $x=-5$ into the LHS

$\therefore$ LHS $=3(-5)^2+6(-5)$

$=3(25)-30$

$=75-30$

$=45=$ RHS

Check $x=3$:

Substitute $x=3$ into the LHS

$\therefore$ LHS $=3(3)^2+6(3)$

$=3(9)+18$

$=27+18$

$=45=$ RHS

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SHORTCUT TO SOLVING EQUATIONS WITH BRACKETS

From the examples on the previous pages it can be seen that there is a **quick method** for solving for x when an equation is in the form $ax + b = 0$.

$$(ax+b)(cx-d)=0$$

$\therefore ax + b = 0$ or $cx - d = 0$

$\therefore ax = -b$ or $cx = +d$

$\therefore x = -\dfrac{b}{a}$ or $x = +\dfrac{d}{c}$

- b, d → keep the constant
- a, c → divide by the coefficient of x
- $-$, $+$ → change the sign

This allows you to go from the equation straight to the answer for x.

Example 1: **Solve for x if $(x+6)(x+7)=0$.**

$(1x+6)(1x+7)=0$

$\therefore x = -\dfrac{6}{1}$ or $x = -\dfrac{7}{1}$

$\therefore x = -6$ or $x = -7$

Example 2: **Solve for x if $(2x+5)(3x-2)=0$.**

$(2x+5)(3x-2)=0$

$\therefore x = -\dfrac{5}{2}$ or $x = +\dfrac{2}{3}$

Example 3: **Solve for x if $(9x+2)(8x-7)=0$.**

$(9x+2)(8x-7)=0$

$\therefore x = -\dfrac{2}{9}$ or $x = +\dfrac{7}{8}$

Complete Exercise 3 number 2 and 3 on page 310.

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D. MATHEMATICAL MODELLING (WORD PROBLEMS)

In mathematical modelling, you will be **given a scenario in words**. You will **then** have to **make and solve your own equation** from the given scenario. You have already dealt with these in Grade 8. We will now extend these to incorporate quadratic equations.

STEPS TO SOLVING WORD PROBLEMS

1. **Identify what you are asked to solve for and call it x.**
2. **Make sure you understand which operation the question is asking you to perform. For example, the sum of is '+'.**
3. **Always state your answer clearly.**

Recap:

Sum of	$\rightarrow$	$+$
Difference	$\rightarrow$	$-$
Product	$\rightarrow$	$\times$
Quotient	$\rightarrow$	$\div$

<u>**Example 1**</u>**: The sum of two consecutive numbers is equal to 171. What are the numbers?**

Let the 1st number $= x$

$\therefore$ The next number $= x + 1 \rightarrow$ consecutive numbers increase in ones

You can now generate an equation:

$x + x + 1 = 171 \rightarrow$ the sum of the 1st and 2nd number is equal to 171

$\therefore 2x + 1 = 171 \rightarrow$ take the 1 over to the RHS

$\therefore 2x = 170 \rightarrow$ divide both sides by 2

$\therefore x = 85$

$\therefore$ The first number is 85 and the second number is 86 $\rightarrow$ answer the question

<u>**Example 2**</u>**: A 1 litre bottle of coke is R2 cheaper than a 2 litre bottle. Four 1 litre bottles and seven 2 litre bottles cost R156,89. How much does each type of bottle cost?**

Let the cost of a 2 litre bottle $= x$

$\therefore$ The cost of a 1 litre bottle $= x - 2$

You can now generate an equation:

$4(x-2) + 7(x) = 156{,}89$

$\therefore 4x - 8 + 7x = 156{,}89$

$\therefore 11x = 156{,}89 + 8$

$\therefore 11x = 164{,}89 \rightarrow$ divide both sides by 11

$\therefore x = 14{,}99$

$\therefore$ A 2 litre bottle of coke costs R14,99 and a 1 litre bottle costs R12,99.

<u>**Example 3**</u>**: The sum of two consecutive even numbers is equal to 150 less than four times the sum of the numbers. What are the numbers?**

Let the first number $= x$

$\therefore$ The second number $= x + 2 \rightarrow$ consecutive even numbers differ by 2

You can now generate an equation:

$x + x + 2 = 4(x + x + 2) - 150 \rightarrow$ 150 less than four times the sum of the numbers

$\therefore 2x + 2 = 4(2x + 2) - 150 \rightarrow$ distribute the 4

$\therefore 2x + 2 = 8x + 8 - 150$

$\therefore 2x + 2 = 8x - 142 \rightarrow$ move the 2 to the RHS and the $8x$ to the LHS

$\therefore -6x = -144 \rightarrow$ divide both sides by -6

$\therefore x = 24$

$\therefore$ The first number is **24** and the second number is **26**.

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Example 4: **Kerry is 10 years older than Gina. In 3 years time she will be twice as old as Gina. How old are Kerry and Gina?**

Let Gina's age $= x$

$\therefore$ Kerry's age $= x + 10 \rightarrow$ Kerry's age is 10 more than Gina's age

Before formulating an equation, you must write down each person's age in 3 years time:

In 3 years time, each person will be 3 years older. Therefore, you add 3 to each person's age:

Gina's age in 3 years time $= x + 3$

$\therefore$ Kerry's age in 3 years time $= x + 10 + 3 = x + 13$

You can now generate an equation using the fact that in 3 years time, Kerry is twice as old as Gina.

$x + 13 = 2(x+3) \rightarrow$ Kerry's age is equal to twice Gina's age

$\therefore x + 13 = 2x + 6 \rightarrow$ the 2 was distributed into the bracket

$\therefore -x = -7$

$\therefore x = 7$

$\therefore$ Gina is 7 years old and Kerry is 17 years old $\rightarrow$ Kerry is 10 years older than Gina

Example 5: **Lerato enters a race which consists of cycling and running. The distance she cycles is twice the distance that she runs. Lerato cycles at an average speed of 20 km/h and runs at an average speed of 5 km/h.**

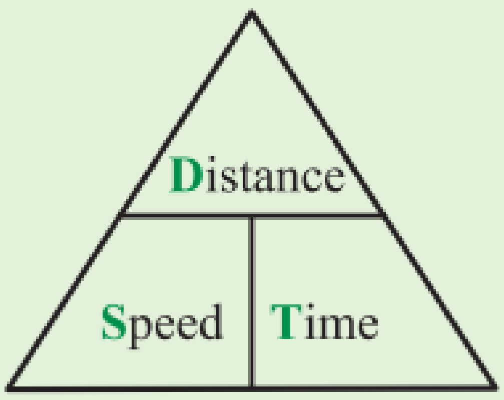
a) If Lerato runs a distance of x km, write down an expression for the time that the running portion of the race takes her. Your answer must be in terms of x.

b) Write down an expression for the time that the cycling portion of the race takes her. Your answer must be in terms of x.

c) Write down an expression in terms of x, for the total time Lerato took to finish the race.

d) If Lerato took 9 hours to complete the race, what distance did she cycle?

When dealing with problems which involve speed, distance and time it is useful to know the triangle and formulas shown in the green block alongside:



$\text{Distance} = \text{Speed} \times \text{Time}$

$\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$

$\text{Time} = \dfrac{\text{Distance}}{\text{Speed}}$

a) $\text{time}_{running} = \dfrac{x}{5} \rightarrow \text{time} = \dfrac{\text{distance}}{\text{speed}}$

b) $\text{time}_{cycling} = \dfrac{2x}{20} \rightarrow$ she cycled twice the distance that she ran

c) $\text{time}_{total} = \dfrac{x}{5} + \dfrac{2x}{20} \rightarrow$ total time = time running + time cycling

d) $9 = \dfrac{x}{5} + \dfrac{2x}{20} \rightarrow$ total time = time running + time cycling

$\therefore 9 = \dfrac{x}{5} + \dfrac{2x}{20} \rightarrow \text{LCD} = 20$

$\therefore \dfrac{9(20)}{20} = \dfrac{x(4) + 2x}{20} \rightarrow$ multiply both sides by 20

$\therefore 180 = 6x \rightarrow$ divide both sides by 6

$\therefore x = 30\,\text{km}$

$\therefore$ Lerato ran 30 km and cycled 60 km. $\rightarrow$ Lerato cycled twice the distance she ran

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Example 6: **The product of two whole numbers is equal to 24. If one number is 5 more than the other, what are the numbers?**

Let the first number $= x$

$\therefore$ The second number $= x + 5 \rightarrow$ the second number is 5 more than the first number

You can now generate an equation:

$x(x+5) = 24 \rightarrow$ the product of the numbers $= 24$

$\therefore x^2 + 5x = 24 \rightarrow$ the x was distributed

$\therefore x^2 + 5x - 24 = 0 \rightarrow$ factorise

$\therefore (x-3)(x+8) = 0$

$\therefore x = 3$ or $x \neq -8 \rightarrow$ the question said that the numbers are whole and -8 is not whole

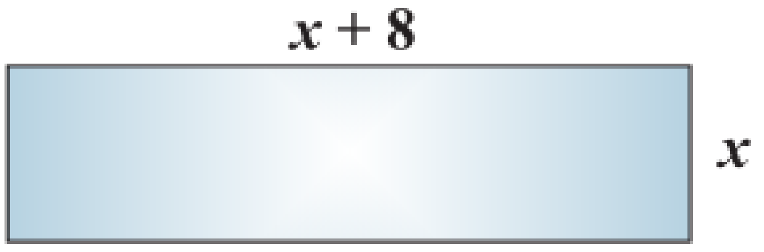
$\therefore$ The first number is **3** and the second number is **8**. $\rightarrow$ second number $= x + 5 = 3 + 5 = 8$

Example 7: **The length of a rectangle is 8 more than its width. If the area of the rectangle is 48 m^2, what are the dimensions of the rectangle?**

Let the width of the rectangle $= x$

$\therefore$ The length of the rectangle $= x + 8 \rightarrow$ the length is 8 more than the width

You can now generate an equation:



$x(x+8) = 48 \rightarrow$ width $\times$ length $=$ Area

$\therefore x^2 + 8x = 48 \rightarrow$ the x was distributed into the bracket

$\therefore x^2 + 8x - 48 = 0 \rightarrow$ factorise

$\therefore (x-4)(x+12) = 0$

$\therefore x = 4$ or $x = -12$

$\therefore x = 4 \rightarrow x \neq -12$ as a length cannot be negative

$\therefore$ The width is **4m** and length is **12m**. $\rightarrow$ length $= x + 8 = 4 + 8 = 12$

Complete Exercise 4 on page 310
and the Mixed Exercise on pages 311 and 312.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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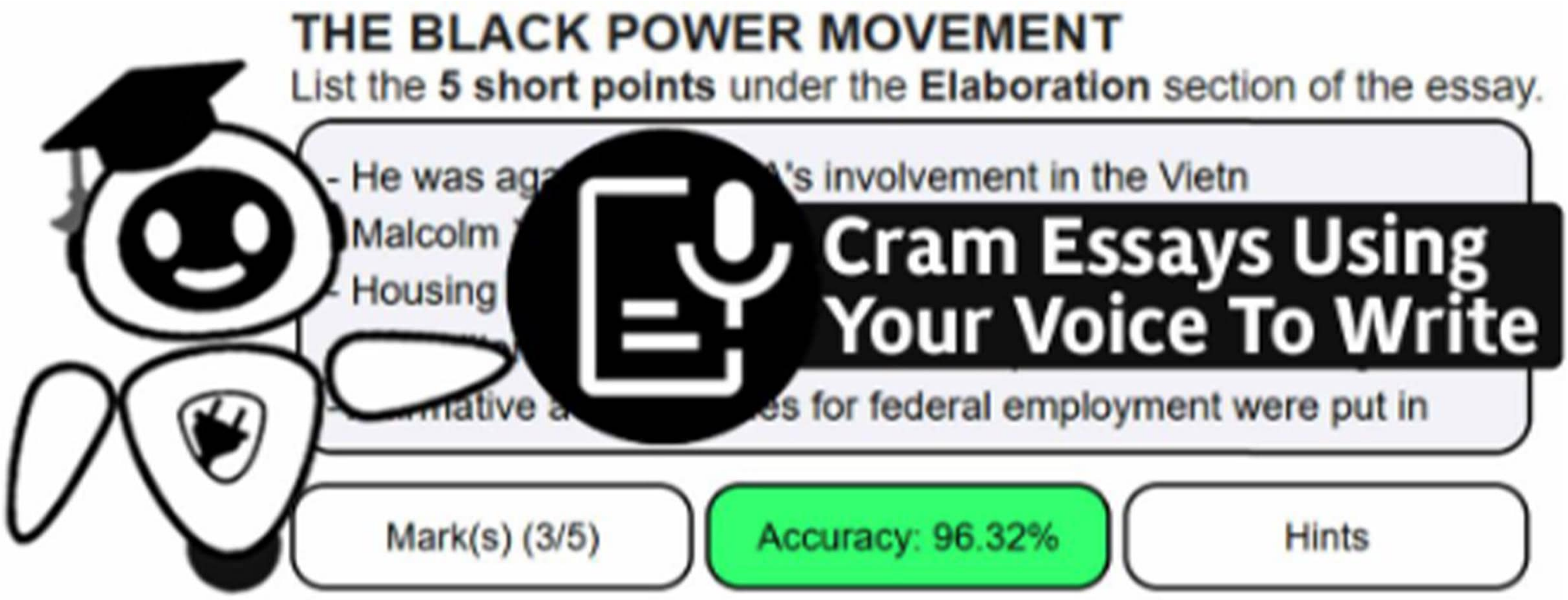

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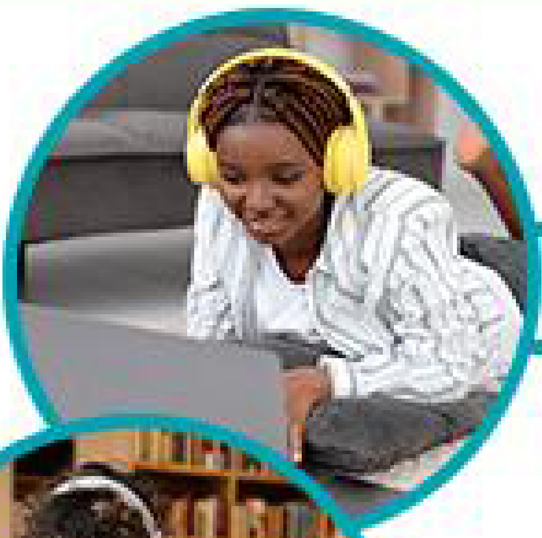

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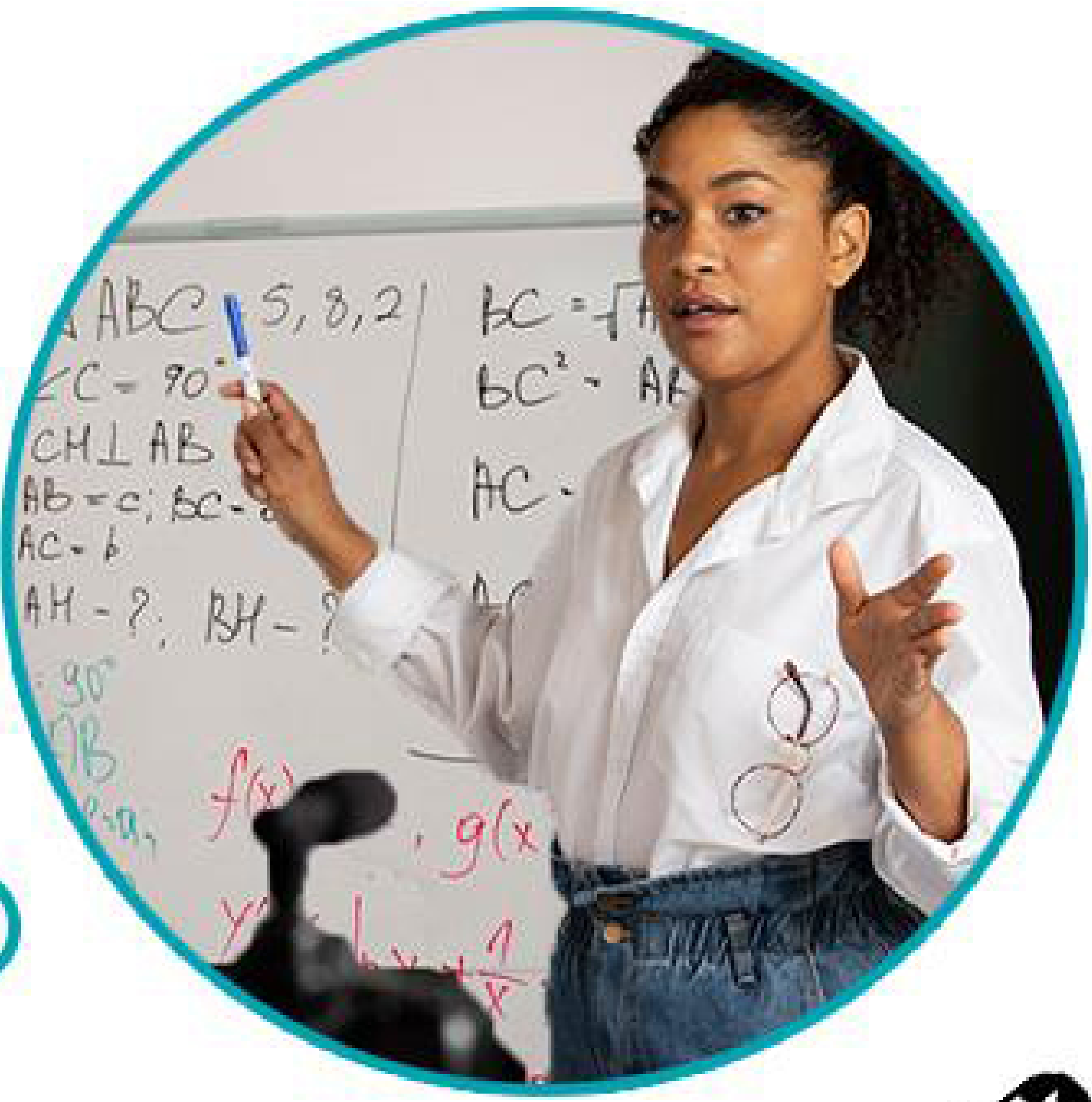
Secondary

Primary



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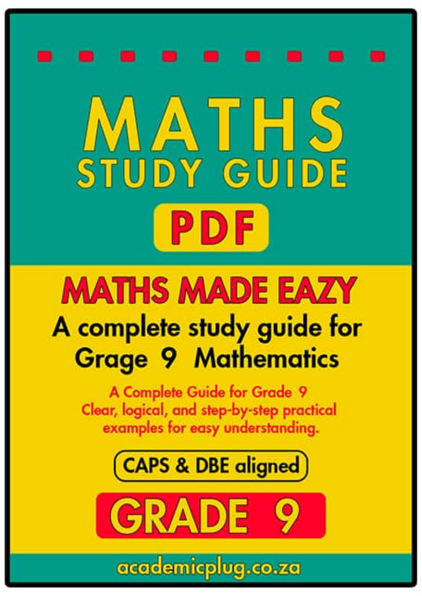

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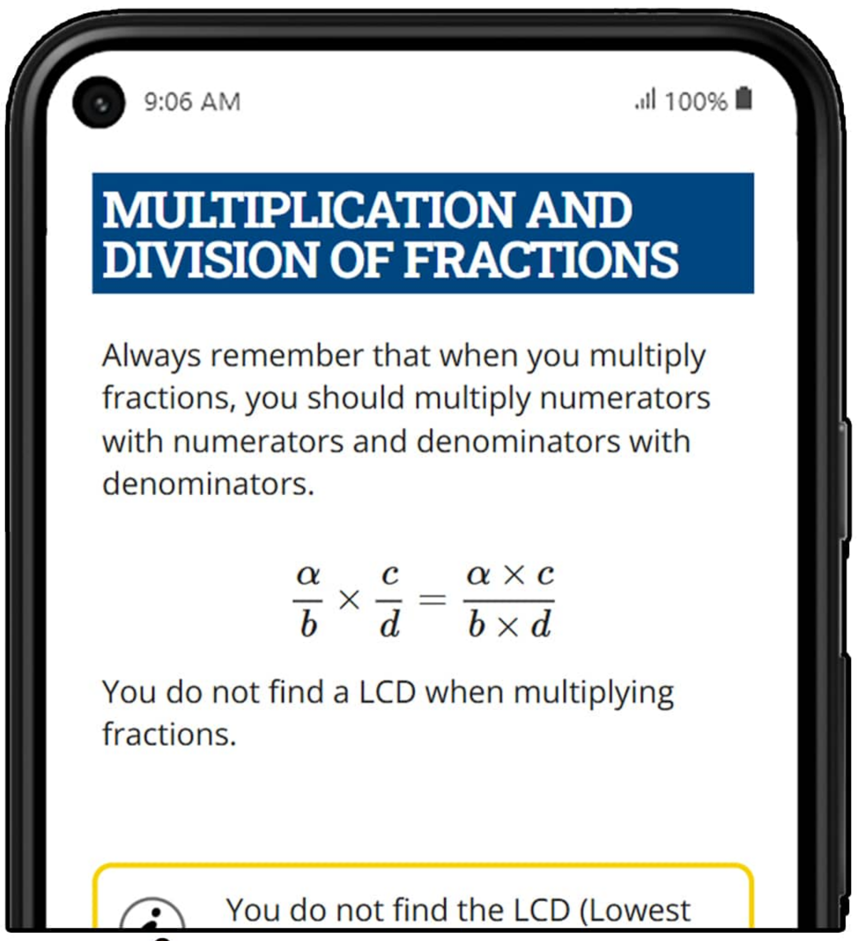

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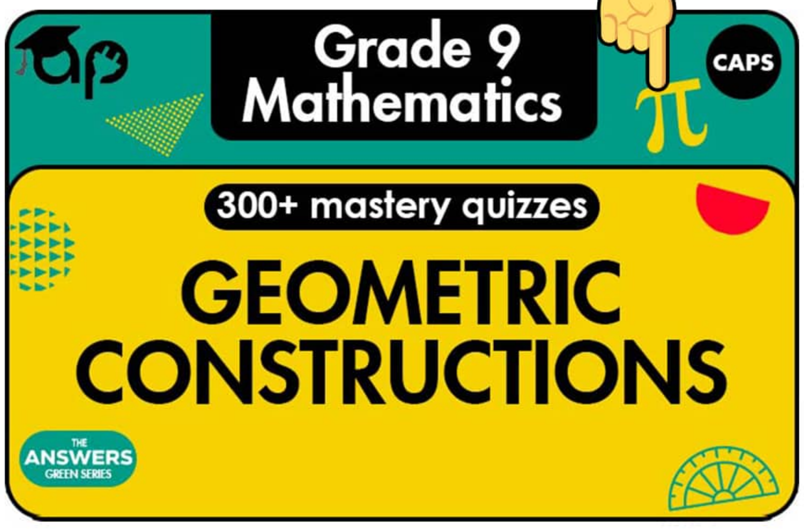

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CHAPTER 11
GEOMETRIC CONSTRUCTIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
106	**A. Grade 8 Revision**	3.5	• Accurately construct geometric figures appropriately using a compass, ruler and protractor, including bisecting angles of a triangle
106	• Terminology and Equipment		• Construct angles of 30°, 45° and 60° and their multiples without using a protractor
106	• Bisecting an angle		• By construction, investigate the angles in a triangle and the relationship between the exterior angle of a triangle and its interior angle
107	• Constructing an angle of 60° and 30°		• By construction, explore the minimum conditions for two triangles to be congruent
108	• Perpendicular lines and the 45° angle		• By construction, investigate sides, angles and diagonals in quadrilaterals, focusing on the diagonals of rectangles, squares, parallelograms, rhombi and kites
110	**B. Constructing Triangles**		• By construction explore the sum of the interior angles of polygons
112	**C. The Four Cases of Congruency**		
115	**D. Quadrilaterals**		
118	**E. Interior Angles of Polygons**		

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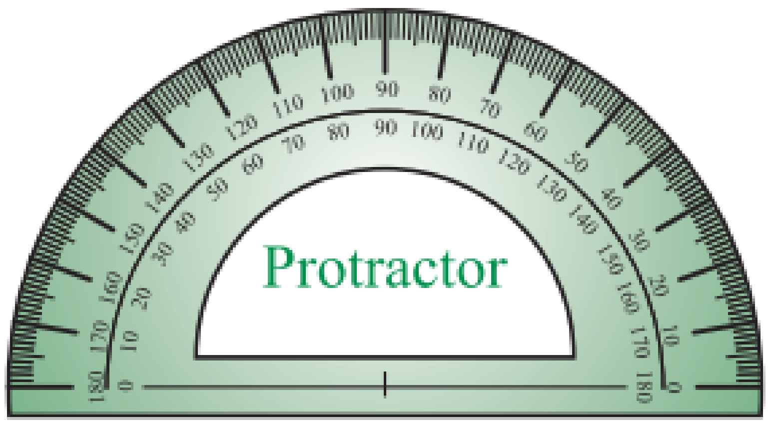
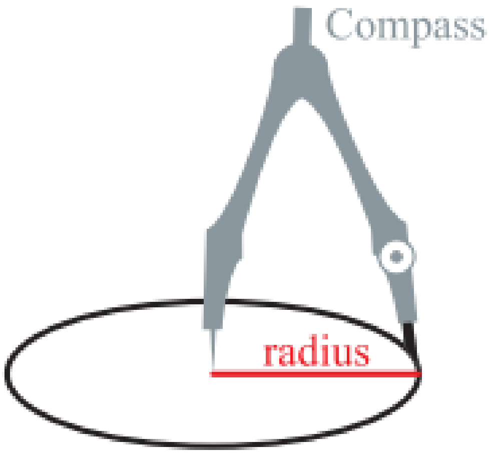
A. GRADE 8 REVISION

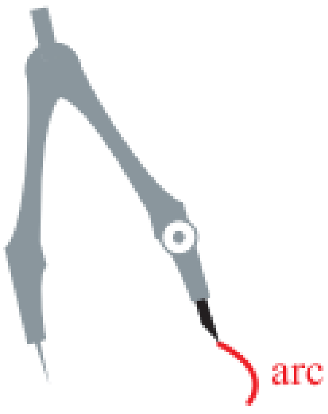
This chapter focuses on exploring angles, triangles and quadrilaterals by construction and measurement. No formal exercises will be performed for this chapter. However, each example can be performed and used as a class activity or exercise.

TERMINOLOGY AND EQUIPMENT

The diagrams below show the important equipment and terminology used in this section.



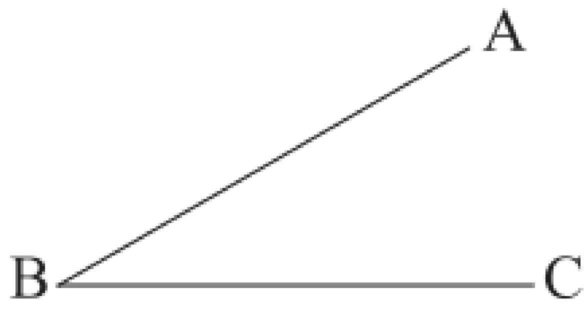
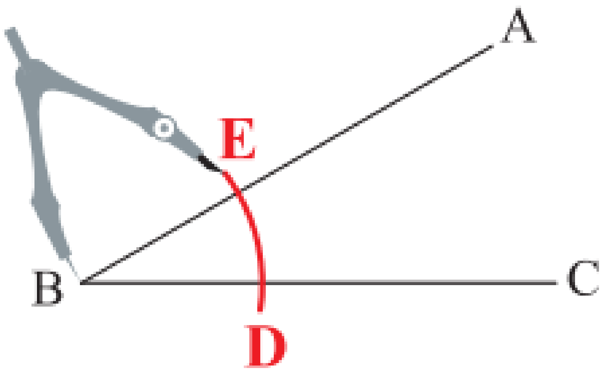
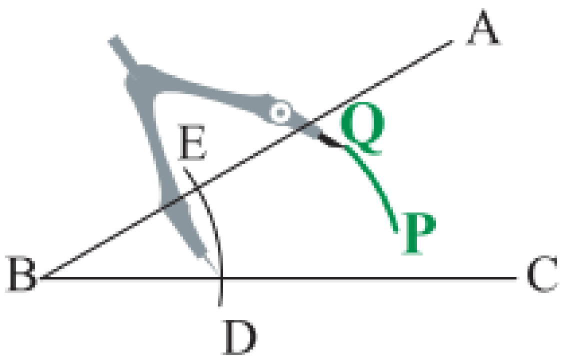
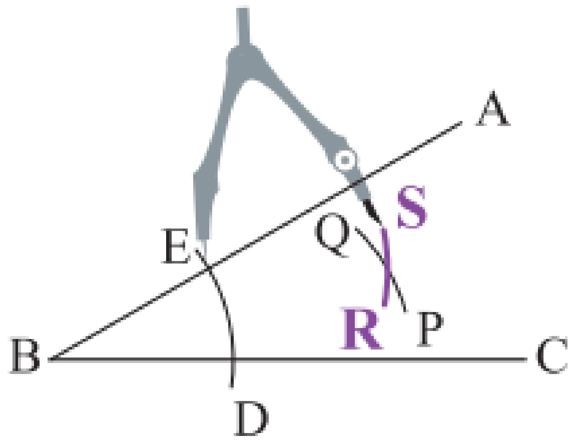
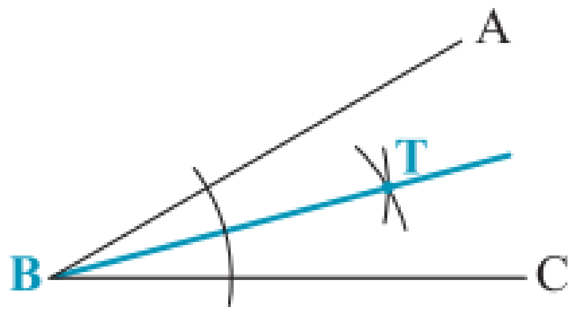




BISECTING AN ANGLE

Bisecting an angle means to **cut an angle in half**. The example below explains how to bisect an angle without a protractor.

Example 1: Bisect any angle $A\hat{B}C$ without using a protractor.

Steps	Diagram
1. Draw any angle $A\hat{B}C$	
2. Place the compass **point** at B and draw arc DE. From this point, **do not change the width of the compass**.	
3. Now place the compass **point** at D (on line BC) and draw arc **PQ**.	
4. Now place the compass point at E (on line AB) and draw arc **RS**.	
5. Now use a ruler and draw a line from point **B** through **T**. **T** is the point of intersection of arcs QP and RS.	

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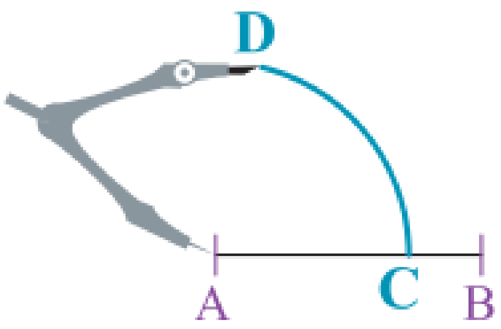
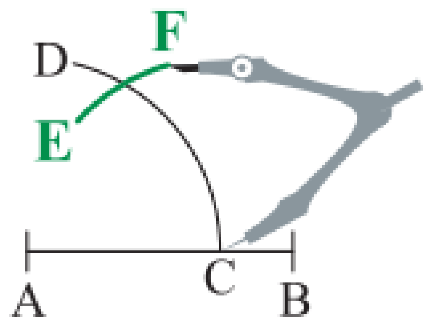
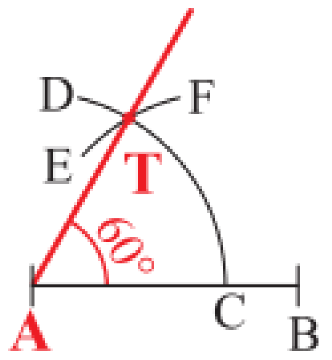
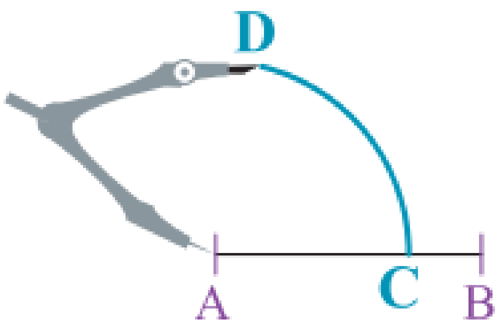
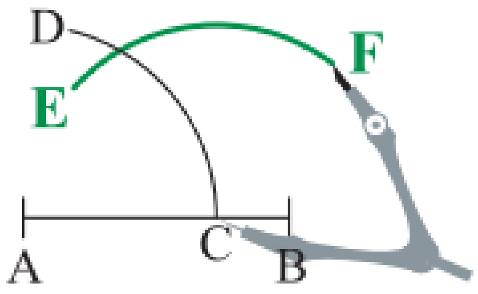
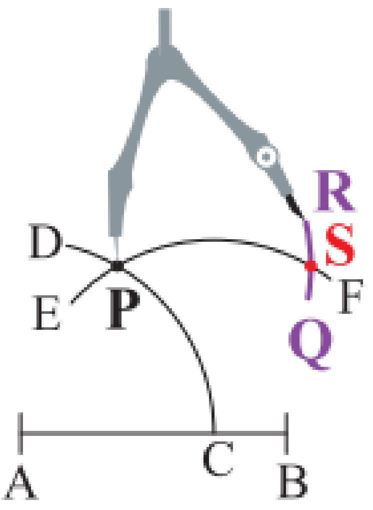
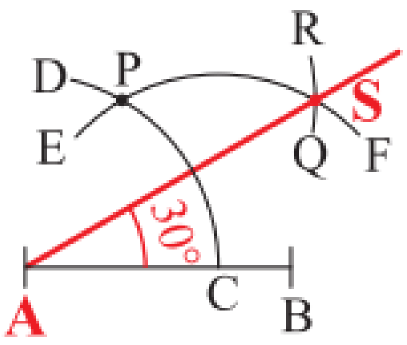
CONSTRUCTING AN ANGLE OF 60° AND 30°

Example 2: Construct a 60° angle without using a protractor.

Steps	Diagram
1. Draw a line segment **AB**. Place the compass **point** at **A** and draw arc **DC**. From this point, **do not change the width of the compass**.	
2. Now place the compass **point** at C and draw arc **EF**.	
3. Now use a ruler and draw a line from point **A** through **T**. **T** is the point of intersection of arcs DC and EF.	

Example 3: Construct a 30° angle without using a protractor.

Steps	Diagram
1. Draw a line segment **AB**. Place the compass **point** at **A** and draw arc **DC**. From this point, **do not change the width of the compass**.	
2. Now place the compass **point** at C and draw arc **EF**.	
3. Now place the compass **point** at **P**. **P** is the point of intersection between arcs DC and EF. Now draw arc **RQ** and mark **S**, the point of intersection of arcs EF and **RQ**.	
4. Use a ruler and draw line from **A** through **S**.	

A 30° angle can also be constructed by constructing a 60° angle as you did in example 2. You can then bisect the 60° angle using the method shown in example 1. Do this as an exercise.

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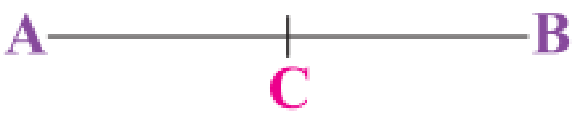
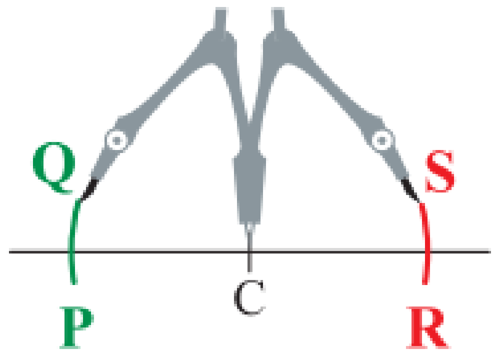
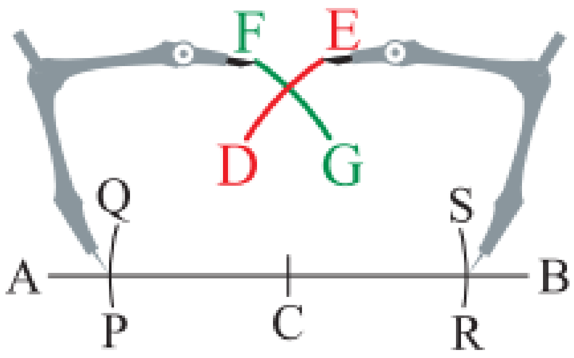
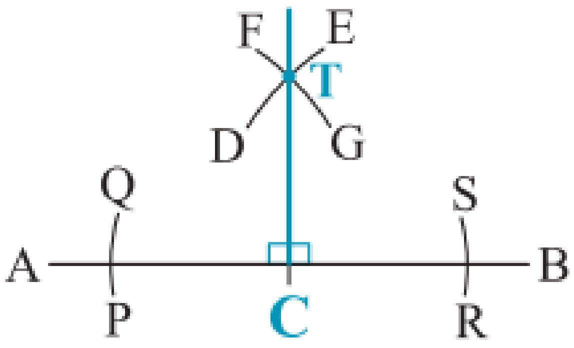
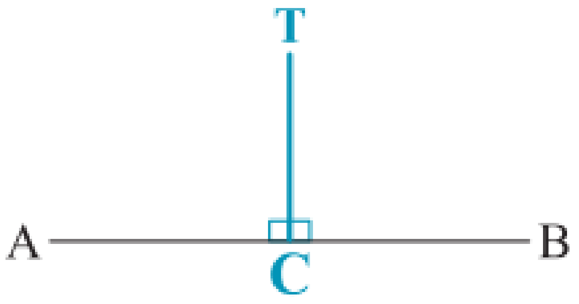
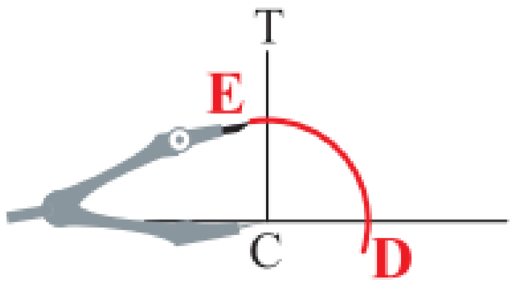
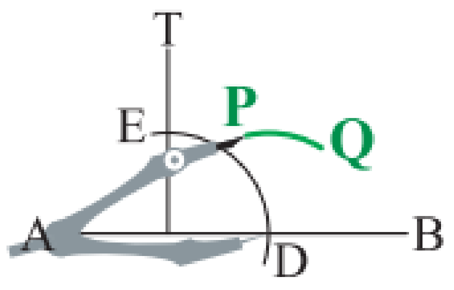
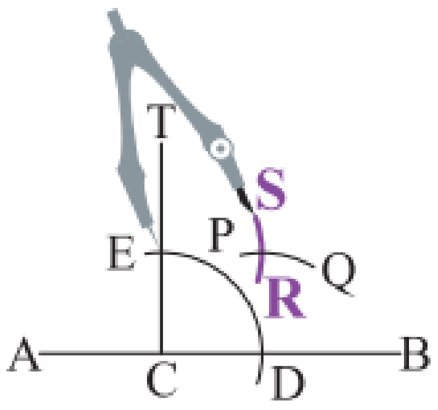
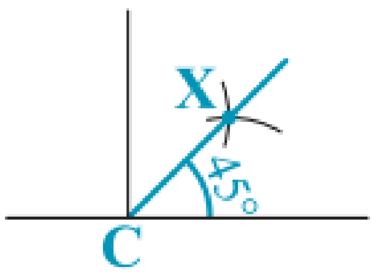
PERPENDICULAR LINES AND THE 45° ANGLE

Example 4: Construct a line perpendicular to AB at C without using a protractor.

Steps	Diagram
1. Draw a line segment **AB**. Mark point **C** anywhere along the line.	
2. Now place the compass **point** at C and draw arc **PQ** and arc **RS**. Now **enlarge your compass width slightly** and **do not change the compass width from this point**.	
3. Now place the compass **point** at **P** on line AB. Draw arc **FG**. Now place the compass **point** at **R** on line AB. Draw arc **DE**.	
4. Use a ruler and draw line from **C** through **T**. T is the point of intersection of arcs FG and DE.	

Example 5: Construct a line 45° to AB at C without using a protractor.

Steps	Diagram
1. Construct a perpendicular line **CT** by completing the steps in Example 4 above. Now **bisect** the **90º** angle using the steps in example 1 on page 106.	
2. Now place the compass **point** at C and draw arc **ED**. From this point, **do not change the compass width**.	
3. Now place the compass **point** at D (on line BC) and draw arc **PQ**.	
4. Now place the compass point at E (on line AB) and draw arc **RS**.	
5. Now use a ruler and draw a line from point **C** through **X**. **X** is the point of intersection of arcs QP and RS.	

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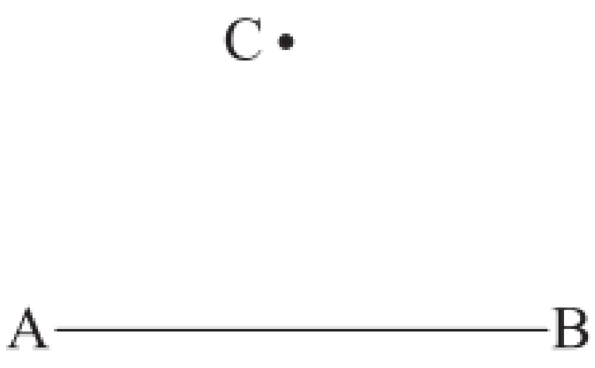
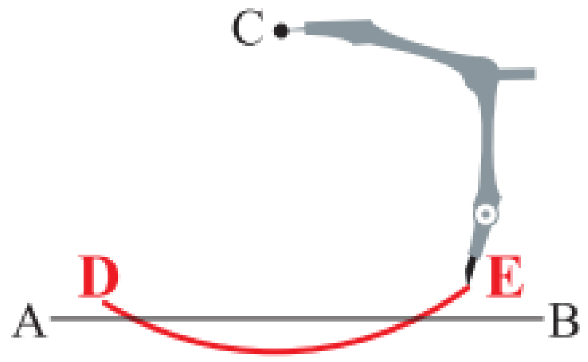
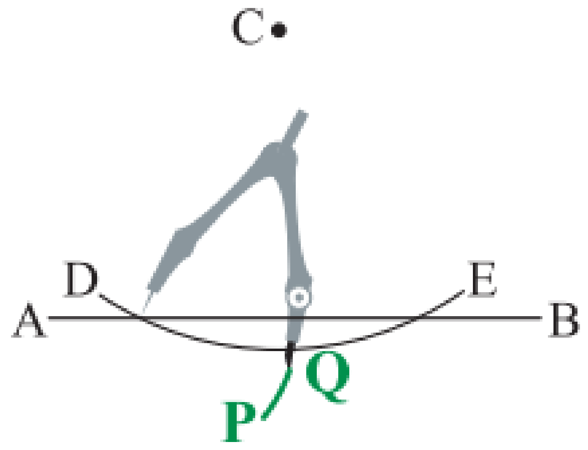
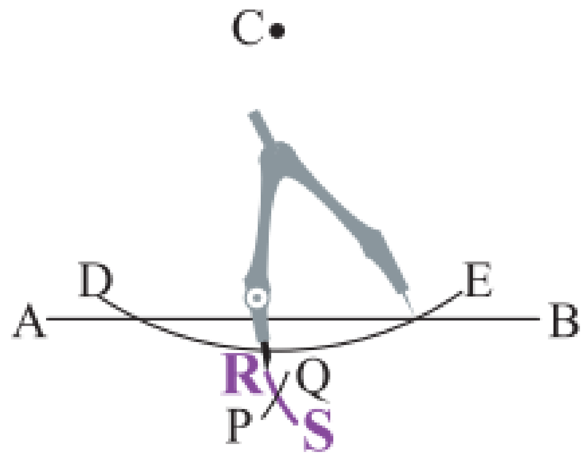
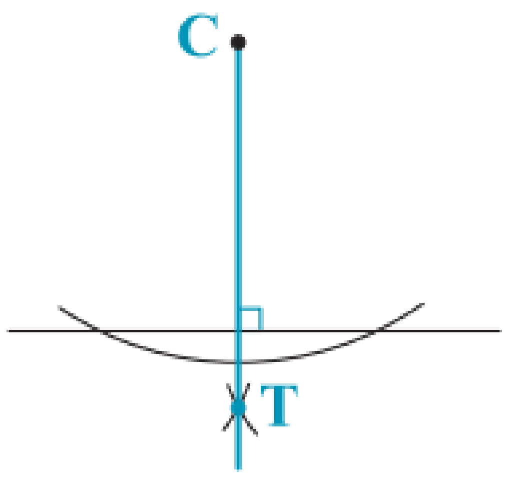
Example 6: **Given the diagram below, construct a line perpendicular to AB from C without using a protractor.**



Steps	**Diagram**
1. Place the **point** of the compass at **C** and draw arc **DE**. Ensure it intersects line AB twice.	
2. Now place the compass **point** at D on line AB and draw arc **PQ**. From this point, **do not change the compass width**.	
3. Now place the compass **point** at E on line AB and draw arc **RS**.	
4. Use a ruler and draw line from **C** through **T**. T is the point of intersection of arcs PQ and RS.	

Example 6 shows how to construct a perpendicular line from a point to a line. Example 4 on page 108 shows how to construct a perpendicular line from a point on a line.

Animations of all the above constructions can be found at
www.mathopenref.com
This is a useful tool for educators in the classroom.

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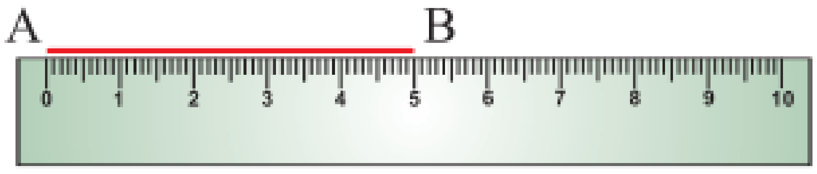
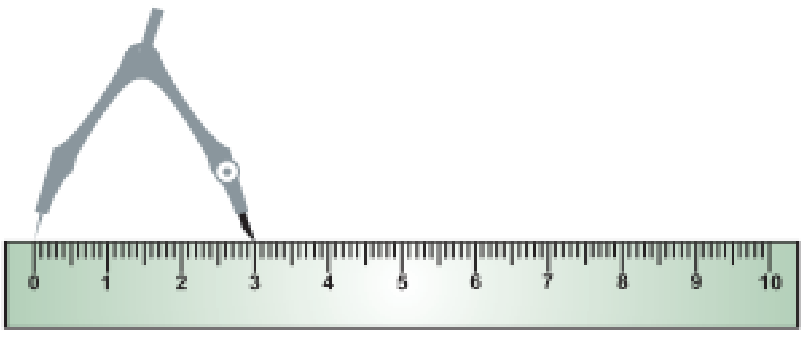
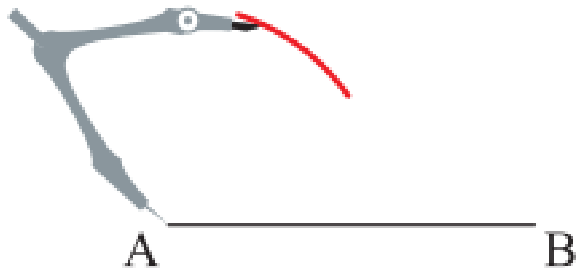
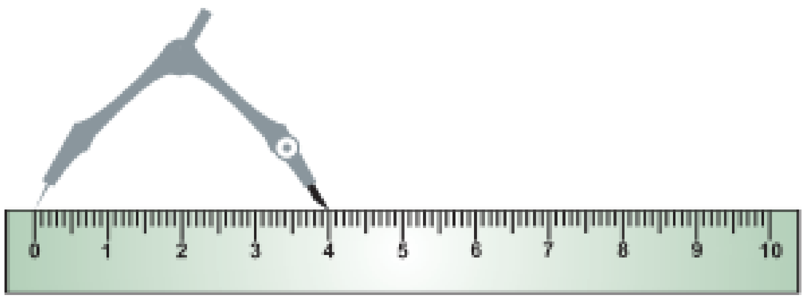
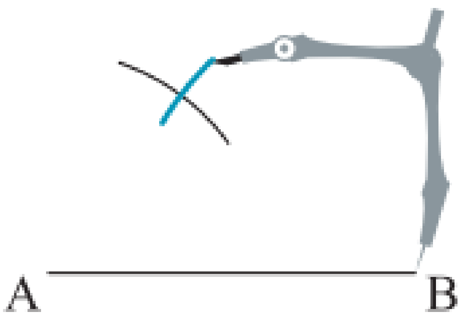
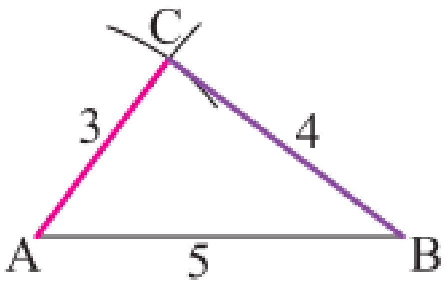
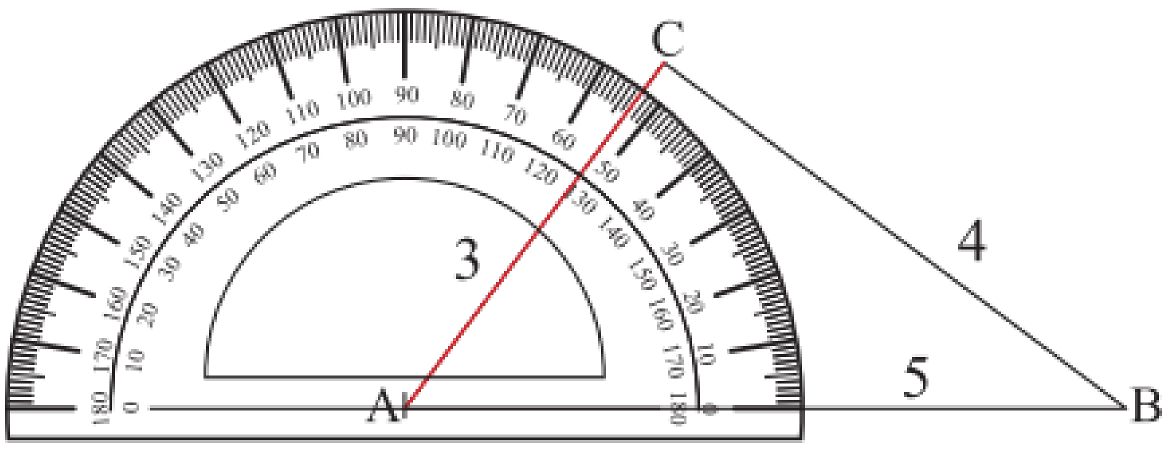
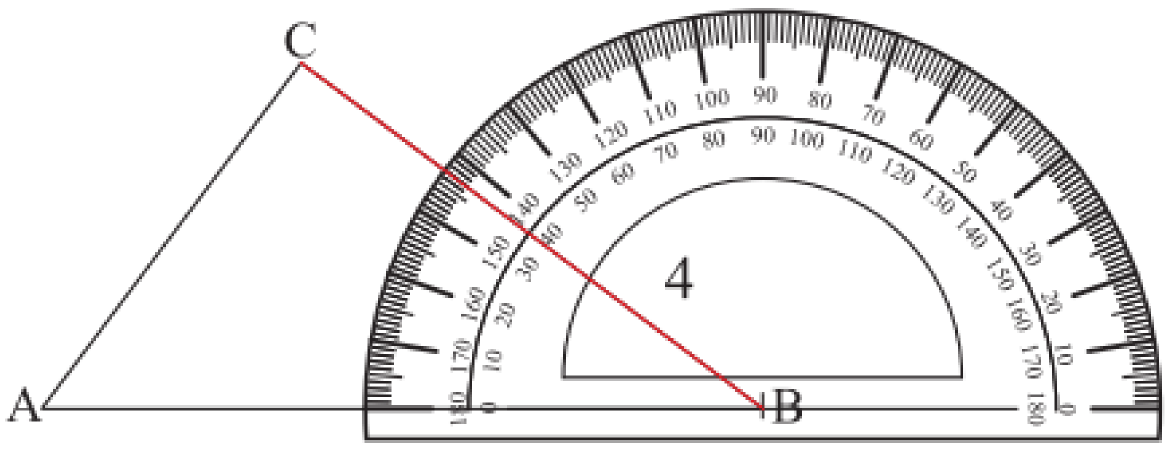
B. CONSTRUCTING TRIANGLES

In Grade 8 you learnt to **draw a triangle given all three sides**. This will be recapped below and you will explore additional properties of triangles by construction.

Example 1: Construct △ABC with AB = 5cm, BC = 4cm and AC = 3cm in length.

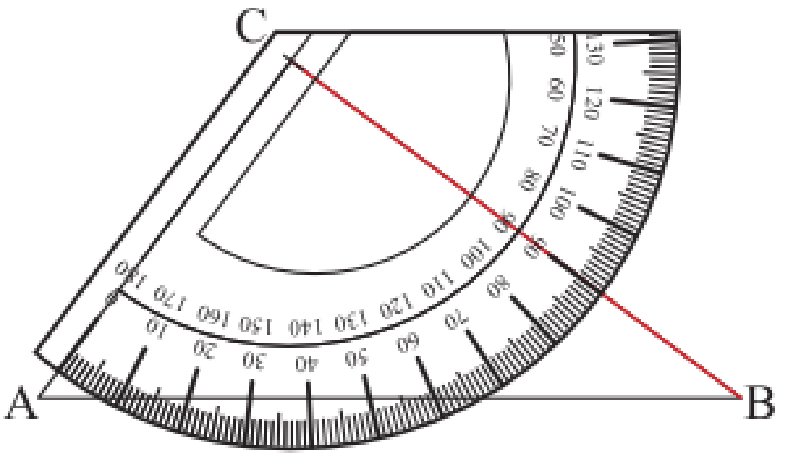
Steps	Diagram
1. Construct a **line** AB, 5cm long using a ruler	
2. Using a compass measure a length of 3cm on a ruler. Lock the compass to this width.	
3. Place the compass point at A on the line drawn in step 1. Draw a large **arc** as shown in the diagram. This will form line AC	
4. Using a compass measure a length of 4cm on a ruler. Lock the compass to this width.	
5. Place the compass point at B on the line drawn in step 1. Draw an **arc** which intersects the arc drawn in step 3.	
6. Now join each end of line AB to the point of intersection of the arcs drawn in step 3 and 5	

Example 2: Using a protractor measure all the interior angles of the triangle drawn in Example 1 and add up the angles.

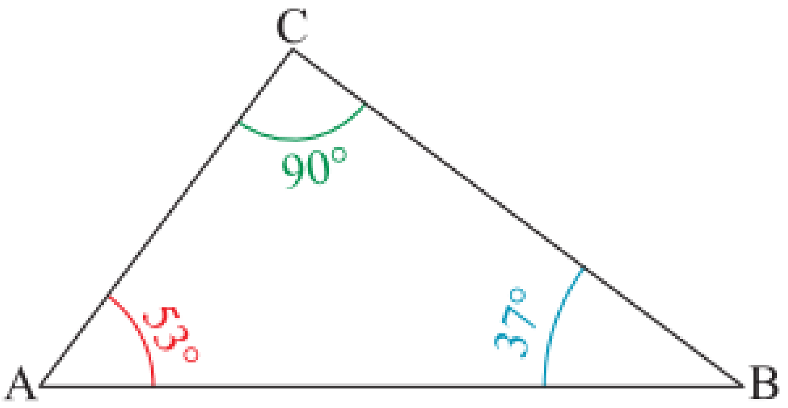
1. Place the centre line of the protractor at vertex A. Read from 0° up to line AC which will give an angle of 53°.	
2. Place the centre line of the protractor at vertex B. Read from 0° up to line BC which will give an angle of 37°.	

A vertex is the point of a triangle formed by two sides.

3. Place the centre line of the protractor at the vertex of the triangle created by the 3cm and 4cm sides of the triangle. Read from 0° up to the line which will give an angle of 90°.



4. Sum of the interior angles $= 53^\circ + 37^\circ + 90^\circ$
$= 180^\circ$

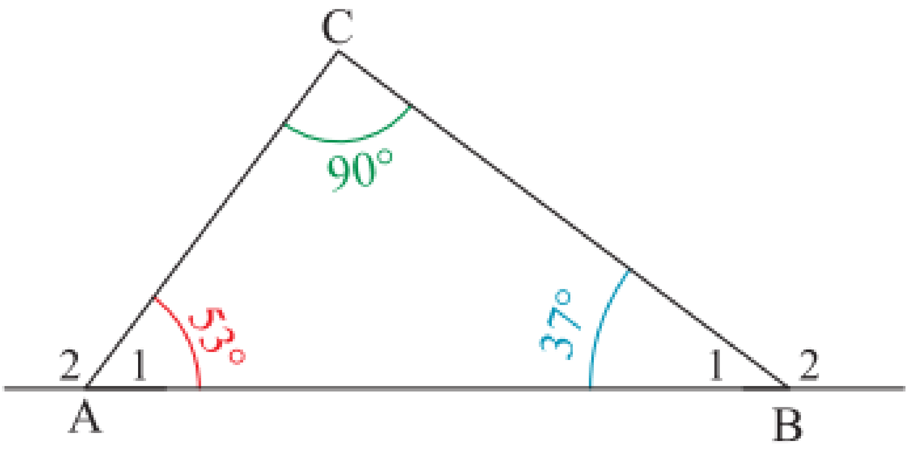


Example 3: Extend line AB in example 2 as shown below. Measure angle $\hat{A}_2$ and $\hat{B}_2$.

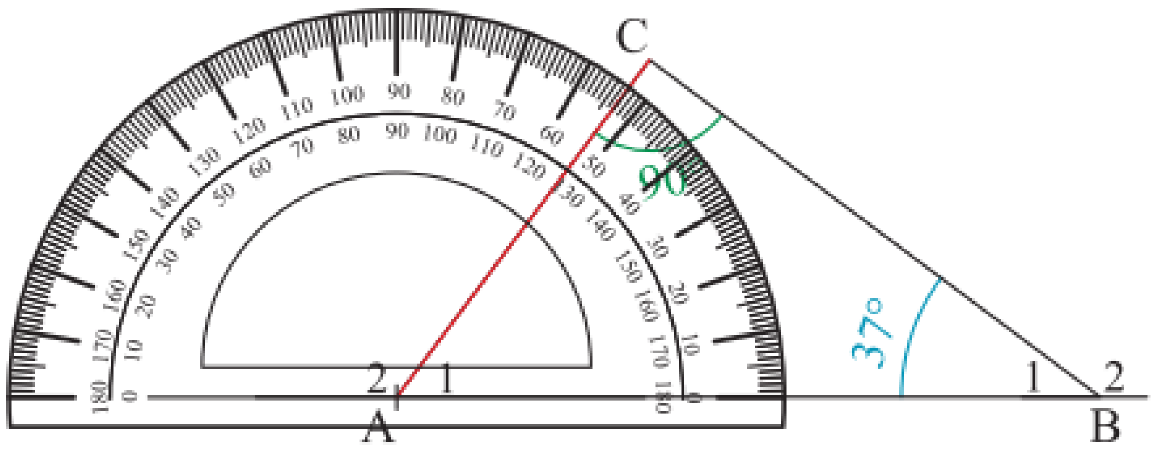
a) Determine the sum of $\hat{B}_1$ and $\hat{C}$.

b) Determine the sum of $\hat{A}_1$ and $\hat{C}$.

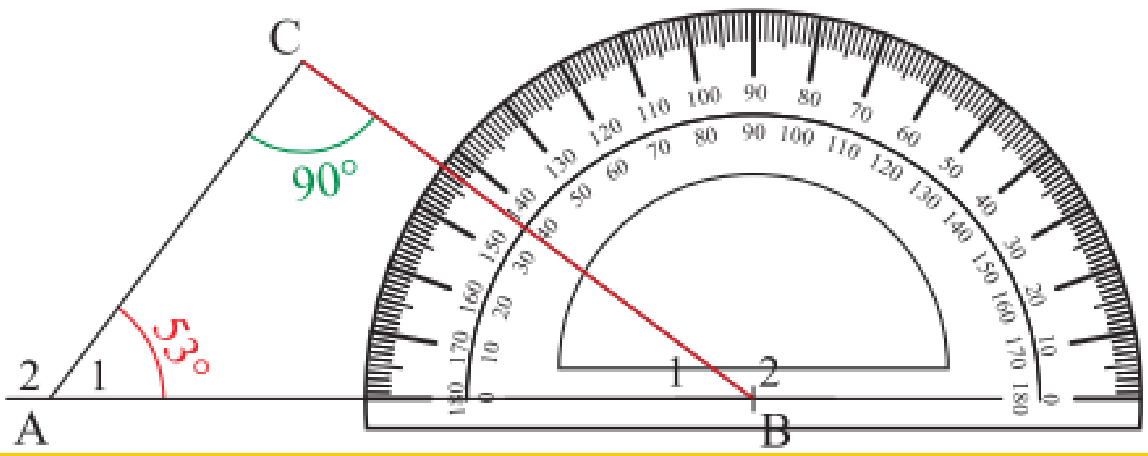
c) What do you notice?



1. Place the centre line of the protractor at vertex A. Read from 0° on the left, up to line AC which will give an angle of 127°.



2. Place the centre line of the protractor at vertex B. Read from 0° on the right up to line BC which will give an angle of 143°.



a) $\hat{B}_1 + \hat{C} = 37^\circ + 90^\circ$
$= 127^\circ$

b) $\hat{A}_1 + \hat{C} = 53^\circ + 90^\circ$
$= 143^\circ$

c) $\hat{A}_2$ and $\hat{B}_2$ are called exterior angles.

The exterior angle of a triangle is equal to the sum of the opposite interior angles.

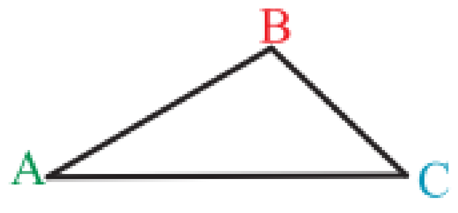
In other words, $\hat{A}_2 = \hat{B}_1 + \hat{C}$ and $\hat{B}_2 = \hat{A}_1 + \hat{C}$

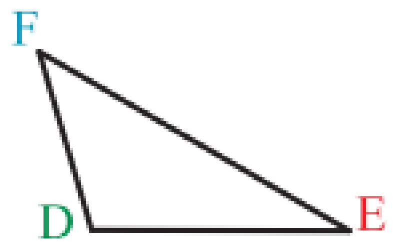
As an exercise, draw your own triangles and verify that the sum of the angles in a triangle sum to 180° and that the exterior angle of a triangle is equal to the sum of the interior opposite angles.

C. THE FOUR CASES OF CONGRUENCY

In Grade 8 you learnt that if **two shapes are congruent they are identical in every way**. This means that **every corresponding side and angle** in each shape **are equal**. Congruency of triangles will be formally dealt with in the next chapter. This section will focus on the four cases for triangles to be congruent using accurate constructions and measurements.

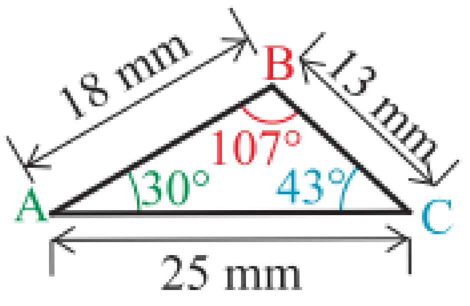
Example 1: △ABC and △DEF are drawn below. Redraw the triangles and measure the sides and angles in each triangle, then complete the statements below:

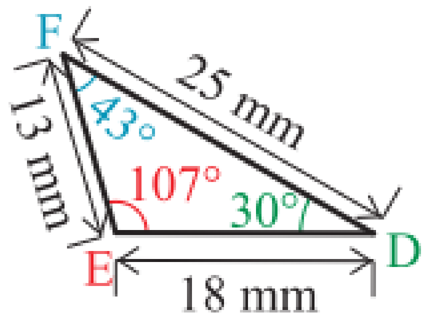




In the triangles above, AB = ___=___mm, BC = ___=___mm and AC = ___=___mm
Angle A = Angle ___=___°, angle B = Angle ___=___° and Angle C =Angle ___=___°.

In the triangles above their corresponding ___________ and _________ are ______. If all the corresponding ____________ of two triangles are ___________, the triangles are ______________. This case of congruency is known as side, side, side (SSS).

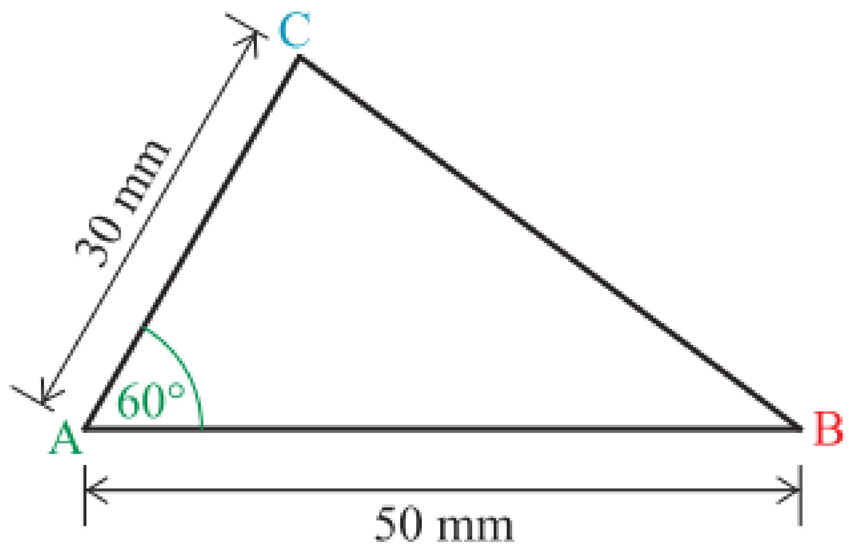


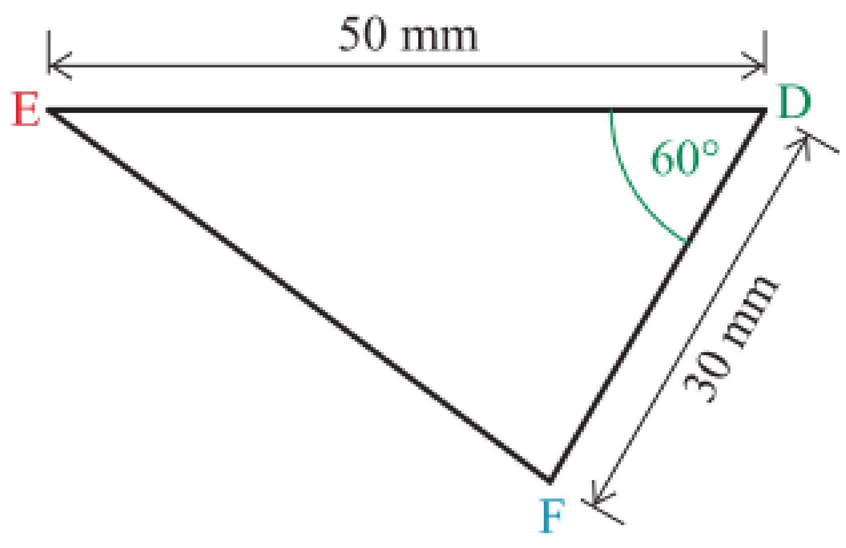


In the triangles above, AB = **DE** = **18**mm, BC = **EF** = **13**mm and AC = **DF** = **25**mm
Angle A = Angle **D** = **30°**, angle B = Angle **E** = **107°** and Angle C =Angle **F** = **43°**.

In the triangles above their corresponding **sides** and **angles** are **equal**.
If all the corresponding **sides** of two triangles are **equal**, the triangles are **congruent**.
This case of congruency is known as Side, Side, Side (SSS).

Example 2: △ ABC and △ DEF are drawn below with measurements as shown. Measure sides CB and EF and complete the statements below.





In the triangles above, two corresponding sides and the __________ between the lines are ________. If the angle is between the lines it is known as an **included angle**.

In the triangles above, BC = ___ = ____mm. If two corresponding sides and the ____________ angle are equal the triangles are ________. This case of congruency is known as Side, Angle, Side (SAS).

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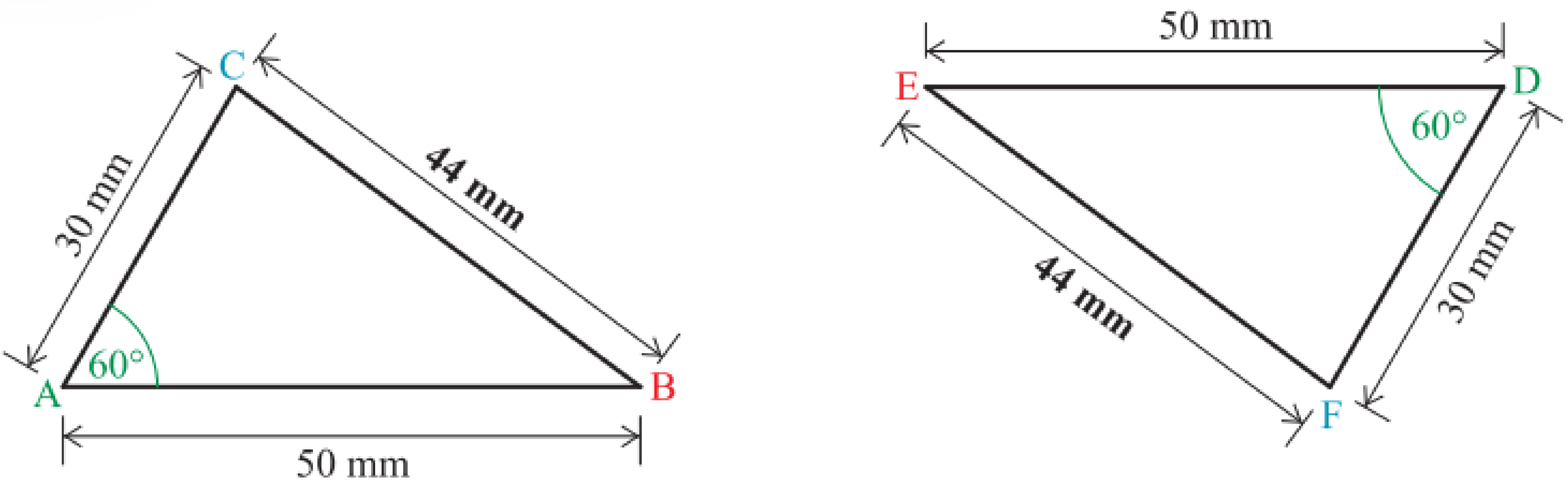
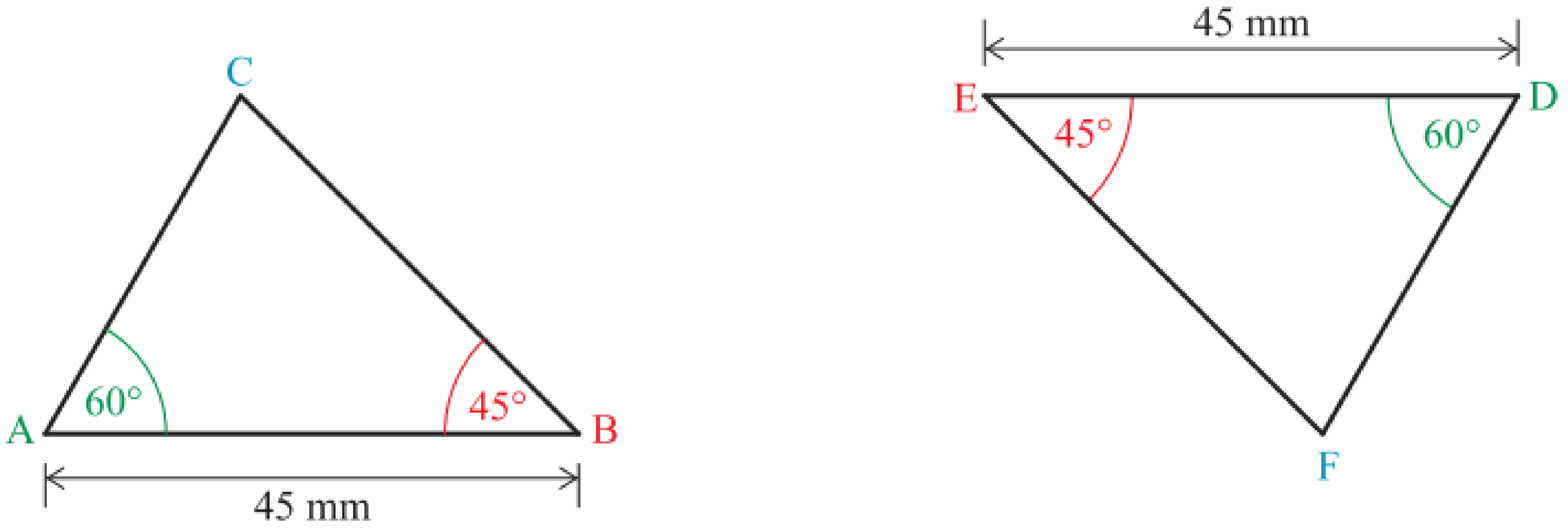


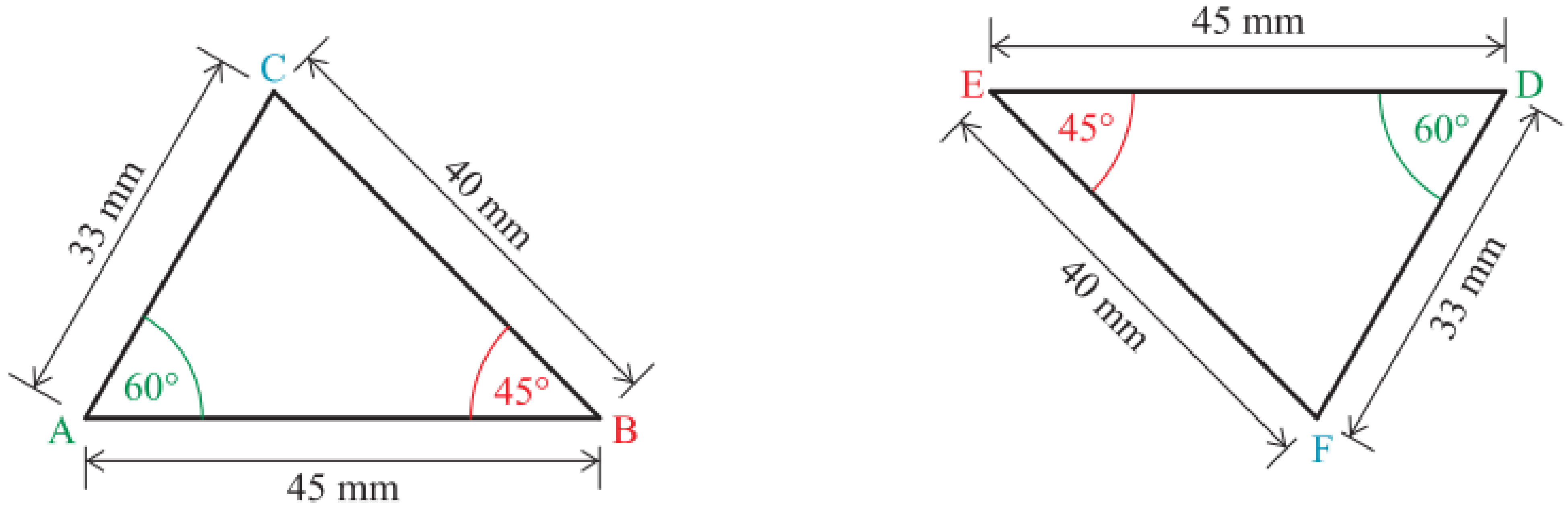
In the triangles above, two corresponding sides and the **angle** between the lines are **equal**. If the angle is between the lines it is known as an **included angle**.

In the triangles above, BC = **EF** = **44**mm. If two corresponding sides and the **included** angle are equal the triangles are **congruent**. This case of congruency is known as Side, Angle, Side (SAS).

Example 3: △ABC and △DEF are drawn below with measurements as shown. Redraw the triangles and measure sides AC, BC, DF, EF and complete the statements below.



In the triangles above, two _________ and a corresponding ______ are __________.
In the triangles above, AC = ____ = _____mm, BC = ____ = _____mm and AB = ____ = _____mm.
If two _______ and a ____________ side are equal the triangles are ________. This case of congruency is known as Angle, Angle, Side or Angle, Side, Angle or Side, Angle, Angle (AAS or SAS or SAA).



In the triangles above, two **angles** and a corresponding **side** are **equal** .
In the triangles above, AC = **DF** = **33**mm, BC = **EF** = **40**mm and AB = **DE** = **45**mm. If two **angles** and a **corresponding** side are equal the triangles are **congruent**. This case of congruency is known as Angle, Angle, Side or Angle, Side, Angle or Side, Angle, Angle (AAS or SAS or SAA).

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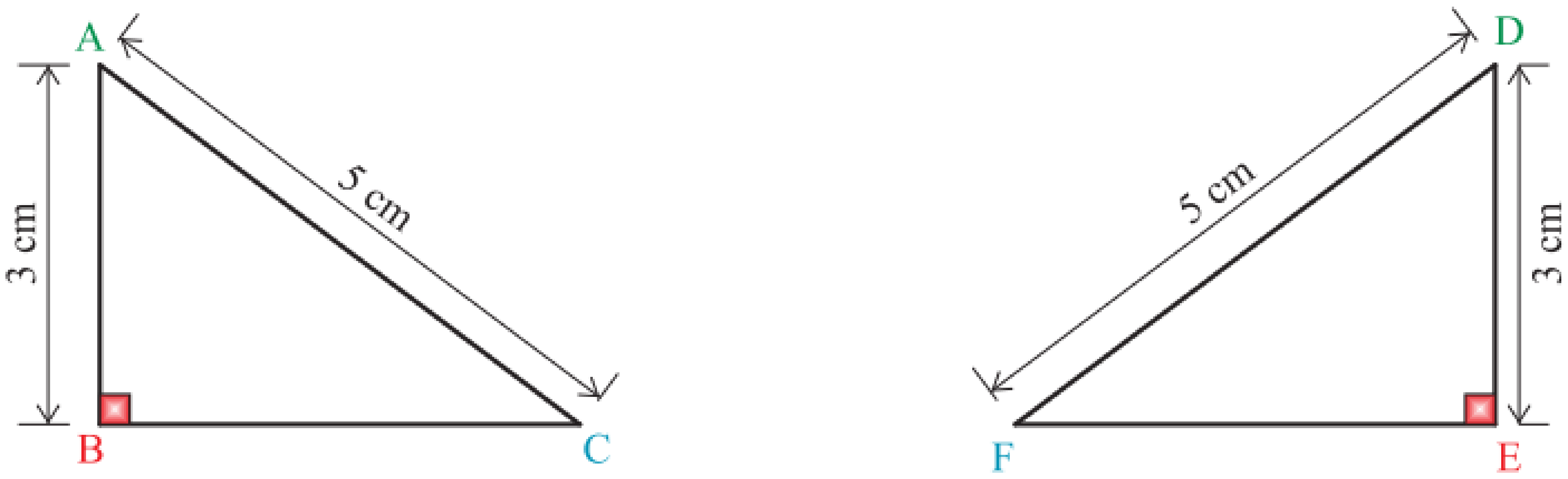
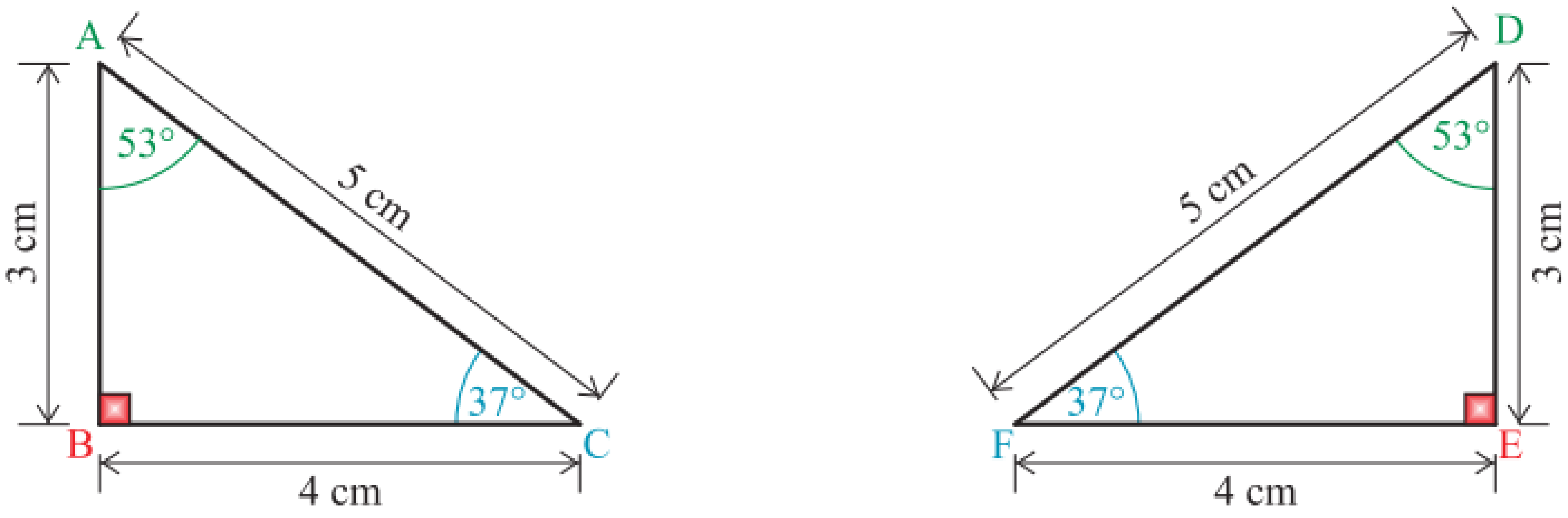
Example 4: $\triangle$ABC and $\triangle$DEF are drawn below with measurements as shown. Redraw the triangles and measure sides BC and FE. Measure angles $\hat{A}, \hat{C}, \hat{F}$ and $\hat{D}$, then complete the statements below.



In the right-angled triangles above, the __________ of each triangle and one other _________ are_______.

BC = ____ = _____cm, $\hat{A}$ = ____ = _____° and $\hat{B}$ = ____ = _____°. If two _______-angled triangles have one ______ and a hypotenuse that are________, the triangles are _________.
This case of congruency is known as Right angle, Hypotenuse, Side (RHS).



In the right-angled triangles above, the **hypotenuse** of each triangle and one other **side** are **equal**.

BC = **EF** = 4cm, $\hat{A} = \hat{D} = 53°$ and $\hat{B} = \hat{E} = 90°$. If two **right**-angled triangles have one **side** and a hypotenuse that are **equal**, the triangles are **congruent**.
This case of congruency is known as Right angle, Hypotenuse, Side (RHS).

SUMMARY

There are **4 conditions for two triangles to be congruent**.
If **any** of the 4 conditions are **satisfied the triangles are congruent**.
The 4 conditions under which triangles are congruent are:

1) **Side, Side Side (SSS)**
2) **Side, Angle, Side (SAS)**
3) **Angle, Angle, Side** or **Side, Angle, Angle** or **Angle, Side, Angle (AAS/SAA/ASA)**
4) **Right Angle, Hypotenuse, Side (RHS)**

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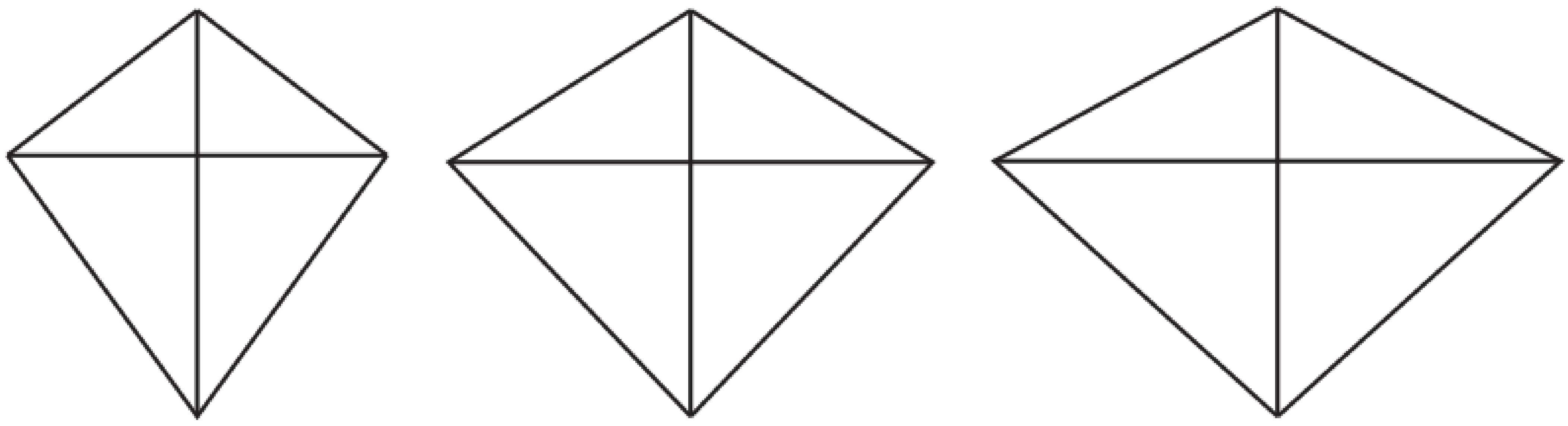
D. QUADRILATERALS

A **quadrilateral** is any shape that **has four sides**. This section will investigate the sides, angles and diagonals of five common quadrilaterals.

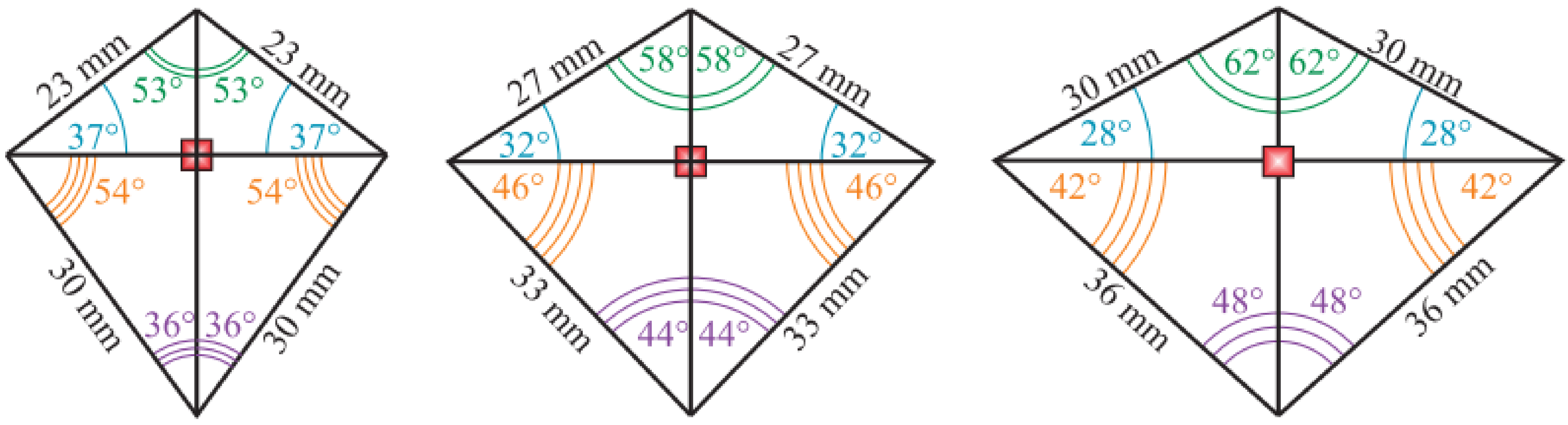
1) **Kite**
2) **Parallelogram**
3) **Rectangle**
4) **Rhombus**
5) **Square**

<u>Example 1</u>: Three different kites are shown below. Measure the sides, diagonals and interior angles of all 3 kites and fill in the missing words.



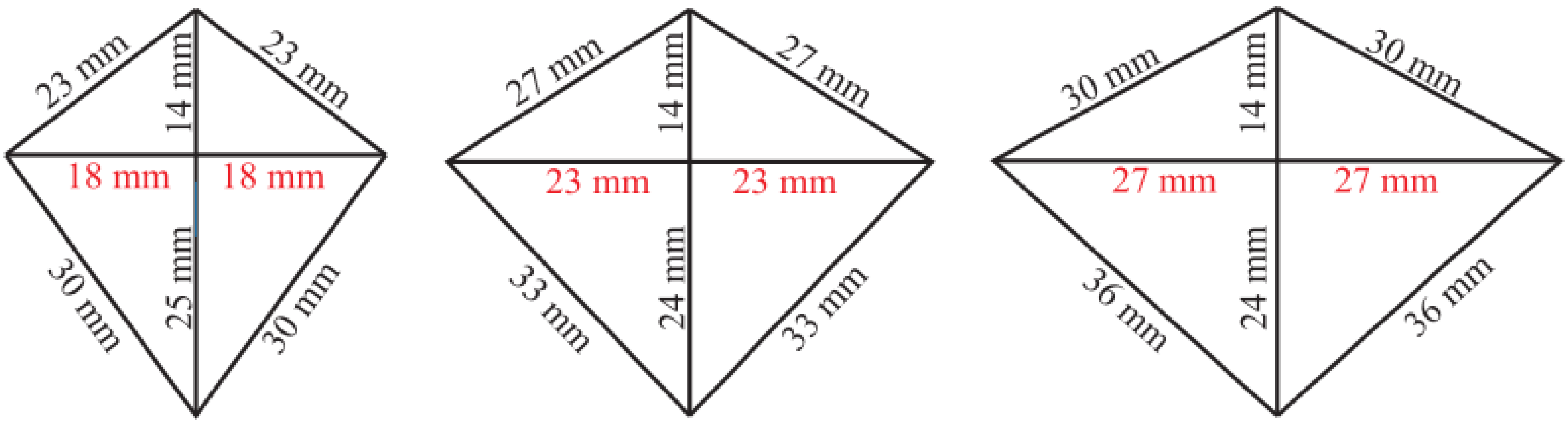
<u>Properties of a Kite:</u>

Two pairs of adjacent sides are ________.
A single pair of opposite ________ are equal.
Diagonals intersect each other at ____°.
The longer diagonal ________ (cuts in half) the corner angles.
The shorter diagonal is ________ (cut in half) by the longer diagonal.



<u>Properties of a Kite:</u>

Two pairs of adjacent sides are **equal**.
A single pair of opposite **angles** are equal. (the pair of **orange** and **blue** angles)
Diagonals intersect each other at **90°**.
The longer diagonal **bisects** (cuts in half) the corner angles. (**green** and **purple** angles)



The shorter diagonal is **bisected** (cut in half) by the longer diagonal.

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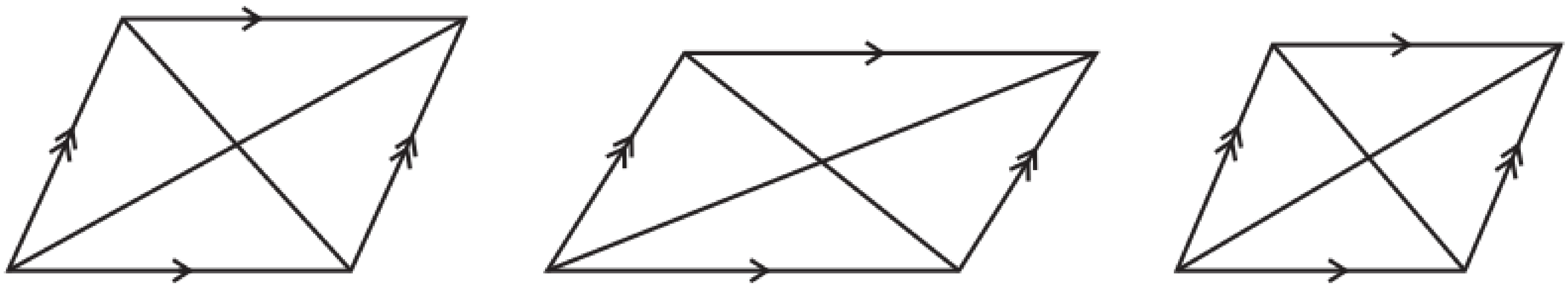
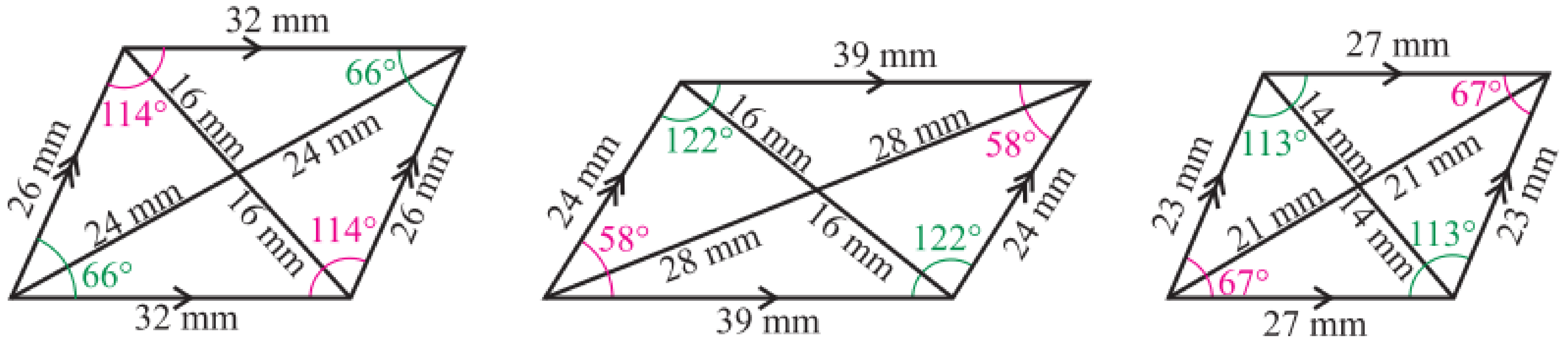
Example 2: **Three different parallelograms are shown below. Measure the sides, diagonals and corner angles of all 3 parallelograms and fill in the missing words.**



Properties of a Parallelogram:

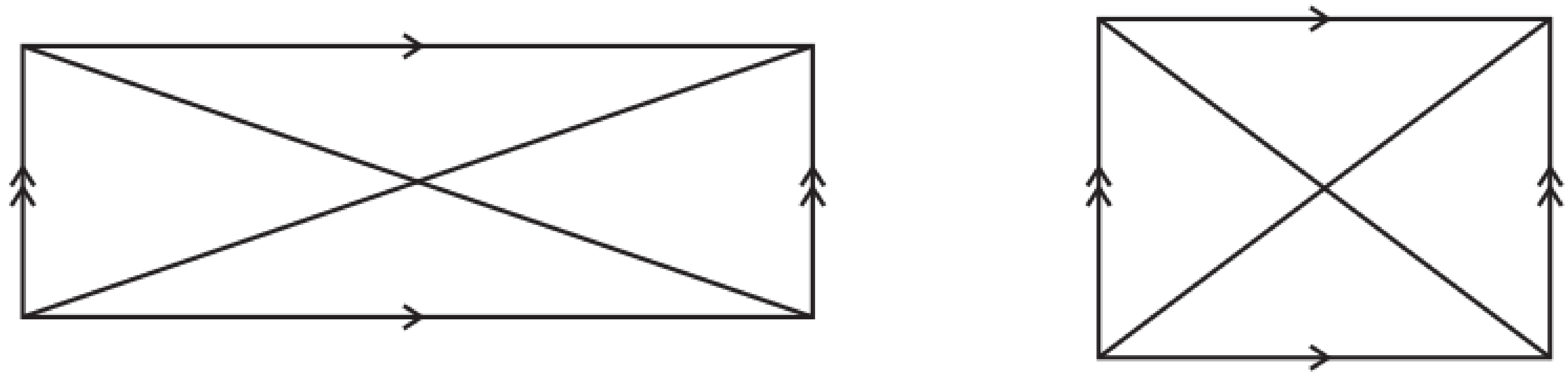
Both pairs of opposite sides are ________ and ________.
Opposite angles are ________.
Diagonals ________ each other.



Properties of a Parallelogram:

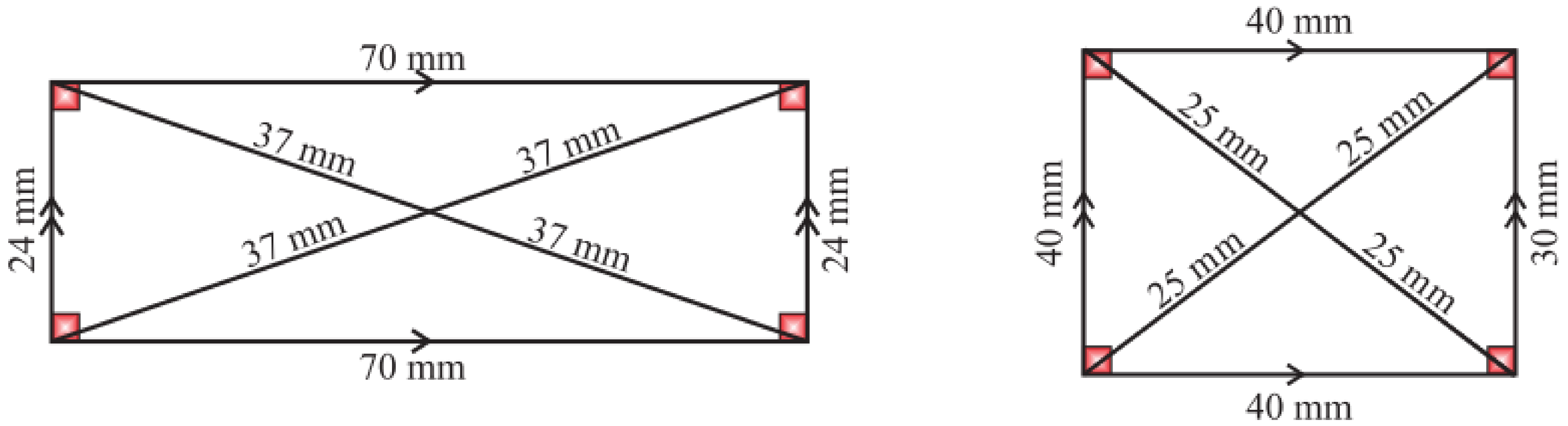
Both pairs of opposite sides are **equal** and **parallel**.
Opposite angles are **equal**.
Diagonals **bisect** each other.

Example 3: **Two different Rectangles are shown below. Measure the sides, diagonals, corner angles and angles where the diagonals intersect and fill in the missing words.**



Properties of a Rectangle:

Both pairs of opposite sides are ________ and ________.
Corner angles are equal to ___°.
Diagonals are ______ in length and _______ each other.



Properties of a Rectangle:

Both pairs of opposite sides are **parallel** and **equal**.
Corner angles are equal to **90°**.
Diagonals are **equal** in length and **bisect** each other.

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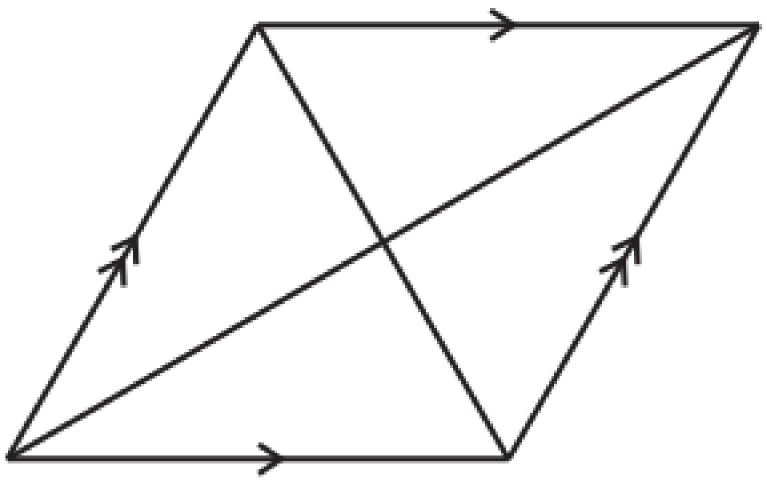
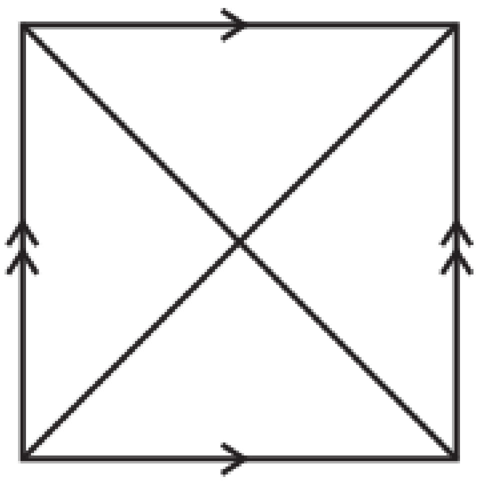
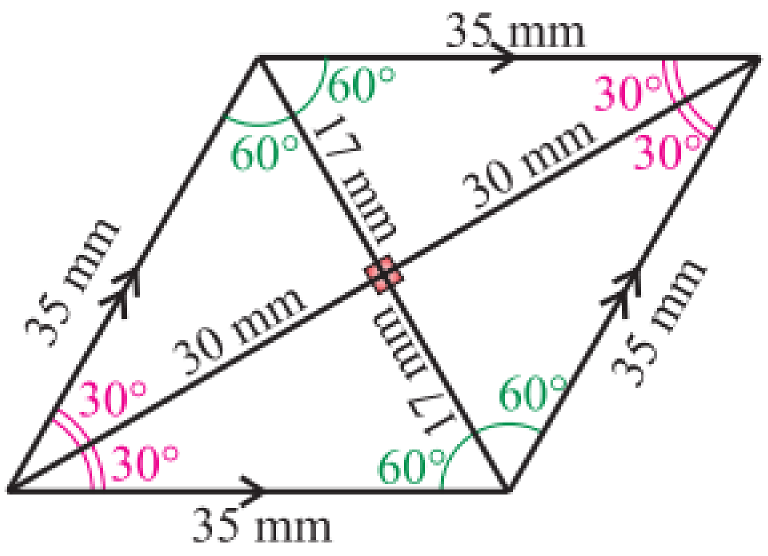
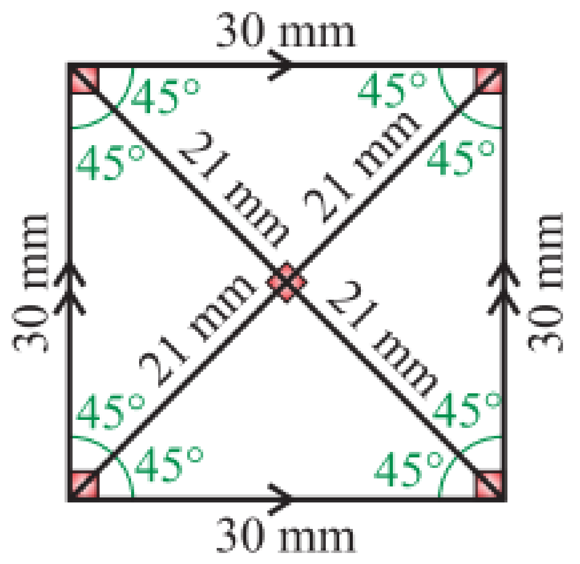
Example 4: **A rhombus and square are shown below. Measure the sides, diagonals, interior angles and angles where the diagonals intersect and fill in the missing words in the table below.**





Properties of a Rhombus:	**Properties of a Square:**
All sides are _______ in length Opposite sides are ________. Opposite angles are ________. Diagonals ______ each other at___°. Diagonals ______ the corner angles.	All sides are _______ in length Opposite sides are ________. Corner angles are equal ___°. Diagonals ______ each other at___°. Diagonals ______ the corner angles. Diagonals are ______ in length.





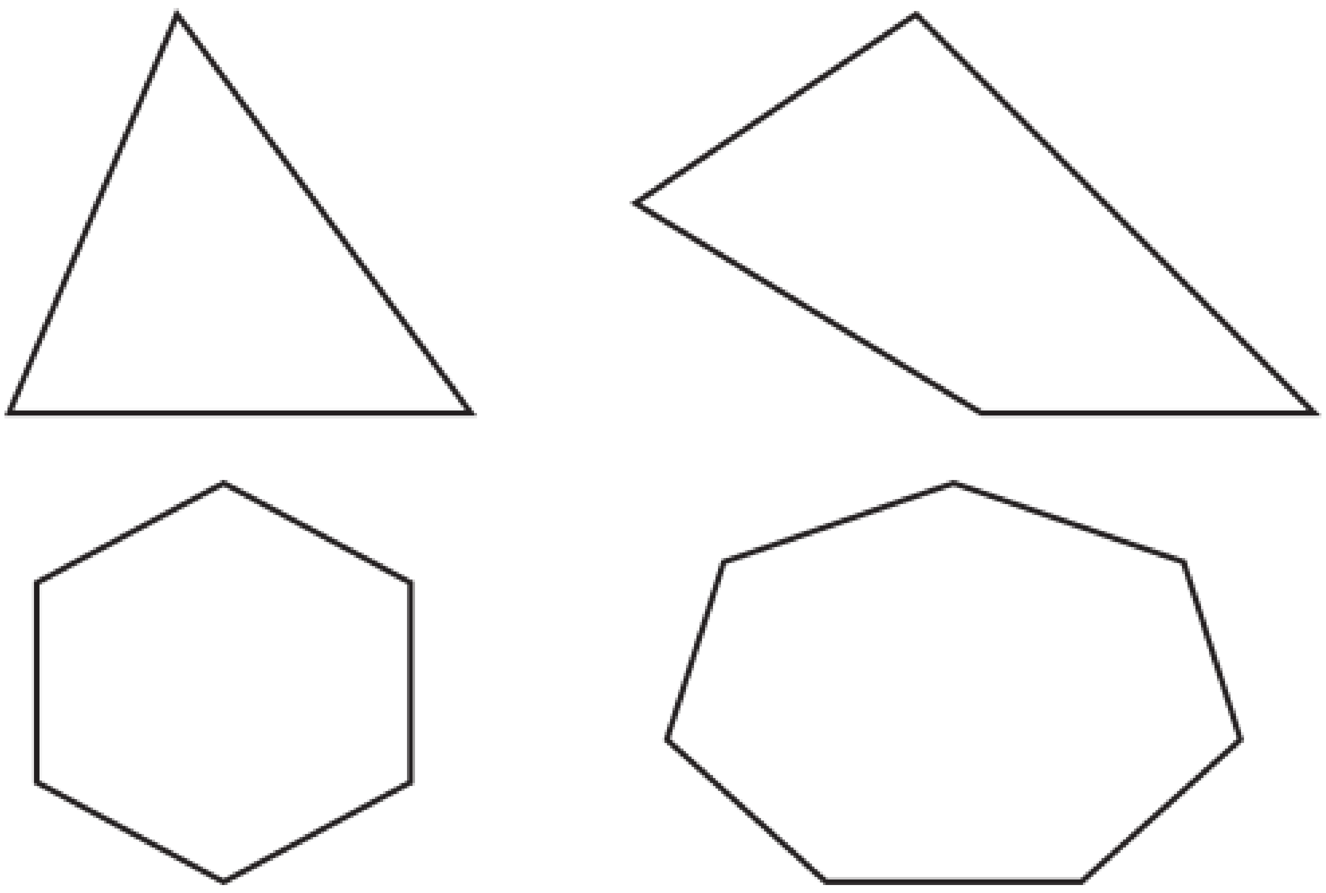
Properties of a Rhombus:	**Properties of a Square:**
All sides are **equal** in length Opposite sides are **parallel**. Opposite angles are **equal**. Diagonals **bisect** each other at **90°**. Diagonals **bisect** the corner angles.	All sides are **equal** in length Opposite sides are **parallel**. Corner angles are equal **90°**. Diagonals **bisect** each other at **90°**. Diagonals **bisect** the corner angles. Diagonals are **equal** in length.

A square is a rhombus which has corner angles equal to 90° and diagonals which are equal.

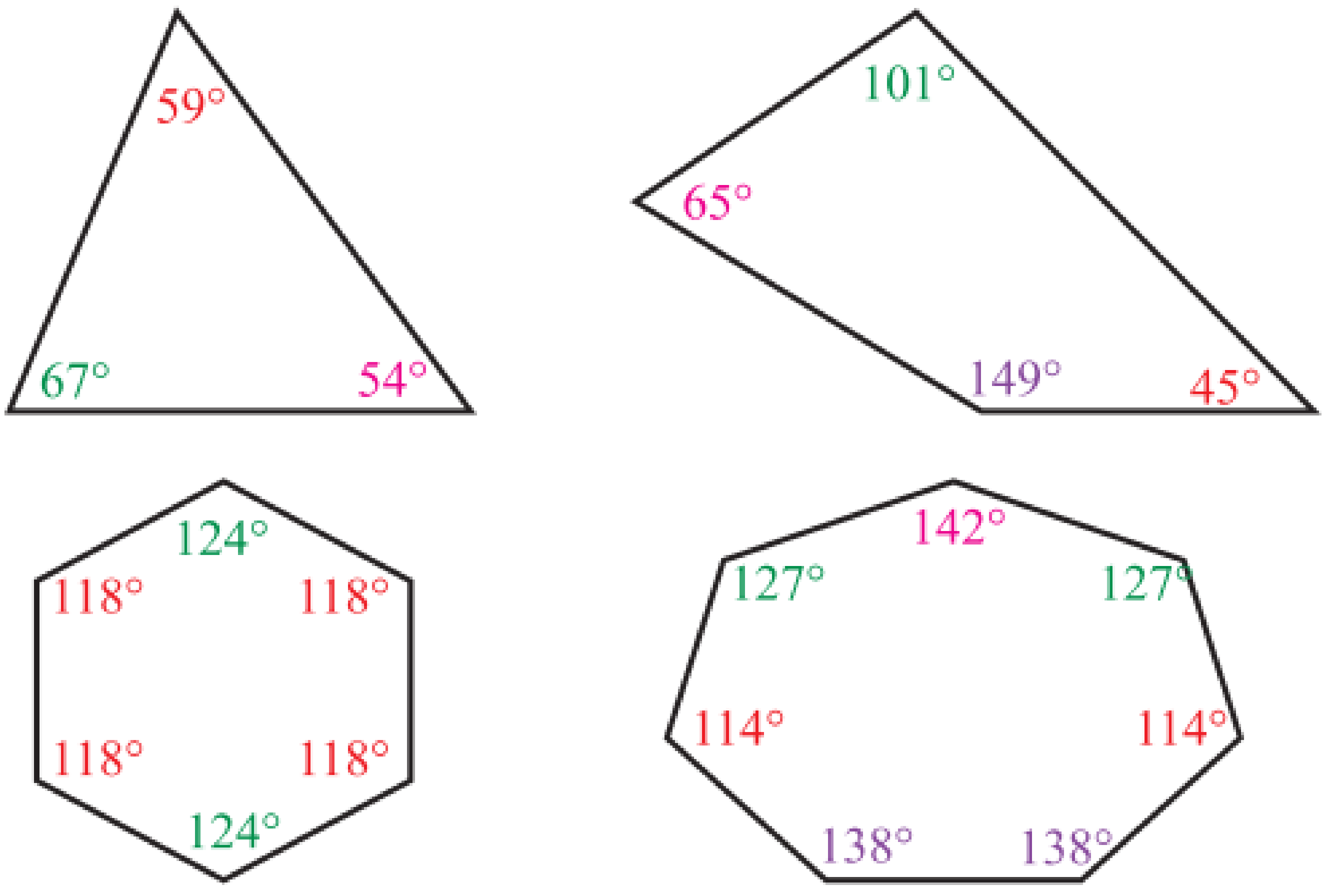
E. INTERIOR ANGLES OF POLYGONS

A **polygon is a closed figure** whose **sides are made up of straight lines**.
A **regular polygon** is a polygon where **all sides** and **interior angles** are **equal**.

Example 1: Various polygons are shown below. Measure the interior angles for each polygon and complete the table below.



Number of Sides (n)	180° (n –2)	Sum of interior angles
3		
4		
5		
6		
7		
8		



Number of Sides (n)	180° (n –2)	Sum of interior angles
3	$180^\circ(3-2)=180^\circ$	180°
4	$180^\circ(4-2)=360^\circ$	360°
5	$180^\circ(5-2)=540^\circ$	540°
6	$180^\circ(6-2)=720^\circ$	720°
7	$180^\circ(7-2)=900^\circ$	900°
8	$180^\circ(8-2)=1080^\circ$	1080°

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From the example on the previous page it can be seen that to calculate the sum of the angles in any polygon, you use the formula:

$$\textbf{Sum of the interior angles of a polygon} = 180^{o}(n-2)$$

where: $n \to$ the number of sides of the polygon

If the polygon is a regular polygon, every angle in the polygon is equal. To calculate the size of each angle in a regular polygon, you use the formula

$$\textbf{Each interior angle of a regular polygon} = \frac{180^{o}(n-2)}{n}$$

where: $n \to$ the number of sides of the polygon

<u>**Example 2**</u>**: Use the above formulas to answer the questions below:**

a) Determine the sum of the interior angles of a polygon which has 12 sides.

b) A regular polygon has 9 sides. Determine the size of each interior angle of the polygon.

c) The sum of the interior angles of a polygon is 1980°. How many sides does the polygon have?

d) An interior angle of a regular polygon is 135°. How many sides does the polygon have?

a) Sum of the interior angles of a polygon $= 180^{o}(n-2)$

$$= 180^{o}(12-2)$$

$$= 1800^{\circ}$$

b) Each interior angle of a regular polygon $= \dfrac{180^{o}(n-2)}{n}$

$$= \frac{180^{\circ}(9-2)}{9}$$

$$= 140^{\circ}$$

c) Sum of the interior angles of a polygon $= 180^{o}(n-2)$

$\therefore 1980^{\circ} = 180^{\circ}(n-2) \to$ distribute the 180°

$\therefore 1980^{\circ} = 180^{\circ}n - 360^{\circ} \to$ take the 360° to the LHS

$\therefore 2340^{\circ} = 180^{\circ}n \to$ divide both sides by 180°

$\therefore n = 13$ sides

d) Each interior angle of a regular polygon $= \dfrac{180^{o}(n-2)}{n}$

$\therefore 135^{\circ} = \dfrac{180^{\circ}(n-2)}{n} \to$ multiply both sides by n

$\therefore 135^{\circ}n = 180^{\circ}(n-2) \to$ distribute the 180°

$\therefore 135^{\circ}n = 180^{\circ}n - 360^{\circ} \to$ take $180^{\circ}n$ to the LHS

$\therefore -45^{\circ}n = -360^{\circ} \to$ divide both sides by -45°

$\therefore n = 8$ sides

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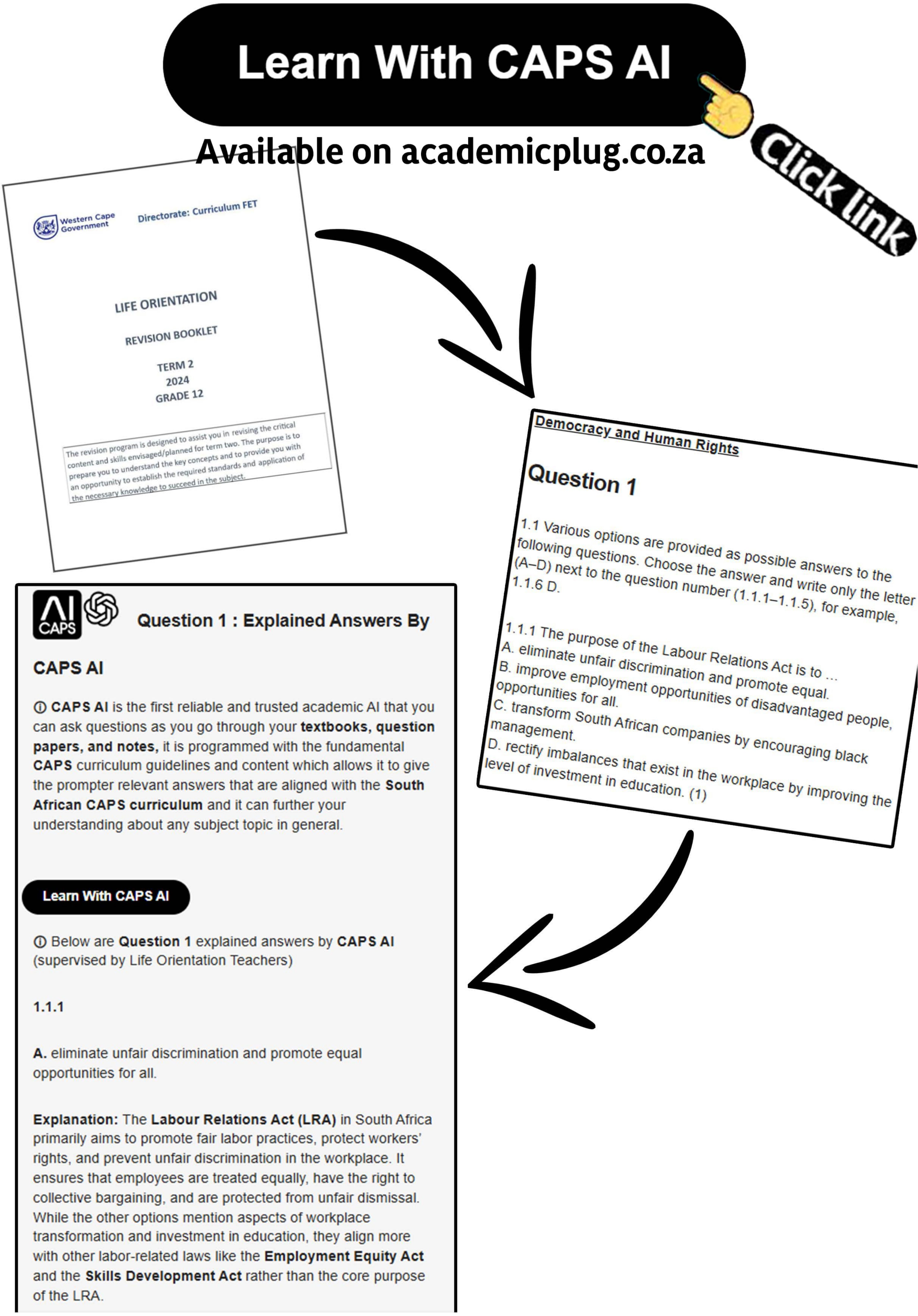
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Democracy and Human Rights
Question 1
1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.
1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)
AI CAPS
Question 1 : Explained Answers By CAPS AI
ⓘ CAPS AI is the first reliable and trusted academic AI that you can ask questions as you go through your textbooks, question papers, and notes, it is programmed with the fundamental CAPS curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the South African CAPS curriculum and it can further your understanding about any subject topic in general.
Learn With CAPS AI
ⓘ Below are Question 1 explained answers by CAPS AI (supervised by Life Orientation Teachers)
1.1.1
A. eliminate unfair discrimination and promote equal opportunities for all.
Explanation: The Labour Relations Act (LRA) in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the Employment Equity Act and the Skills Development Act rather than the core purpose of the LRA.

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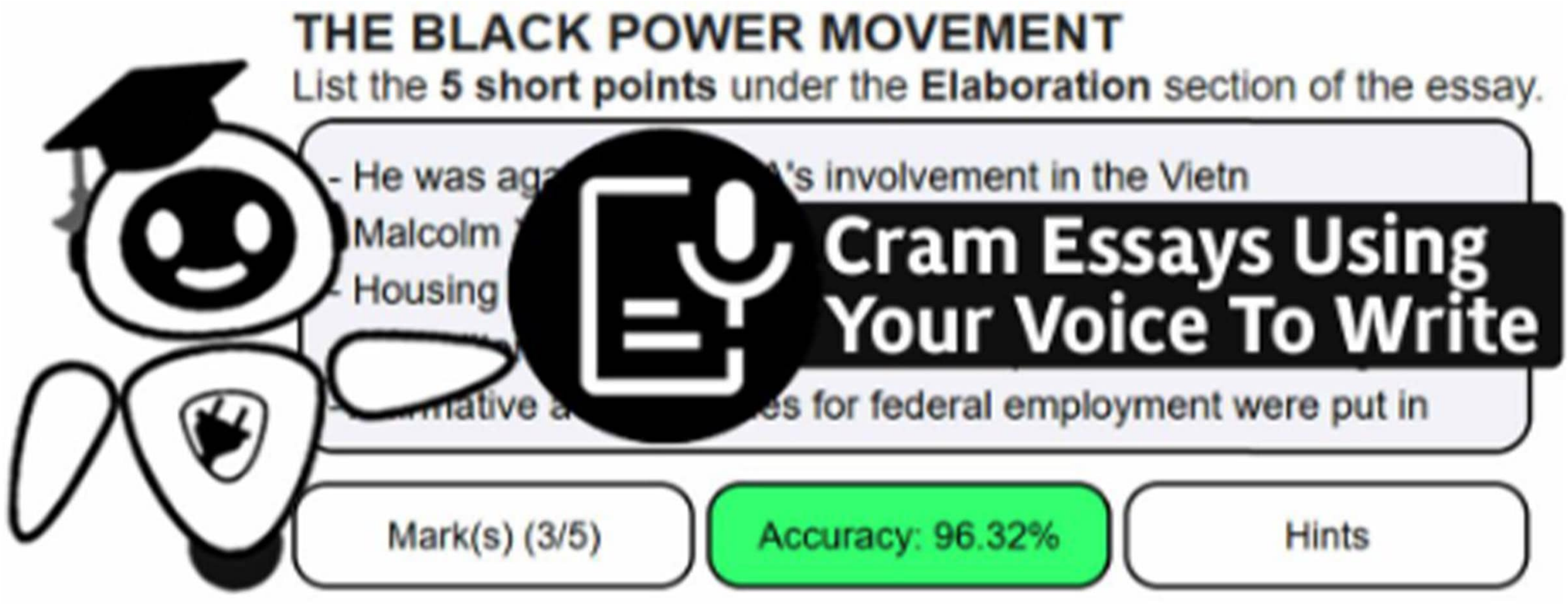

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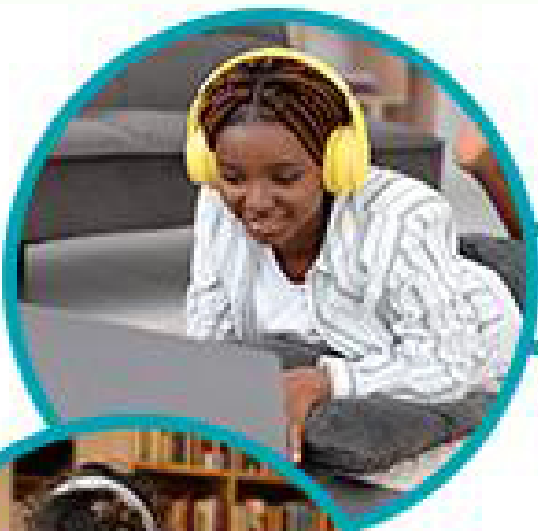
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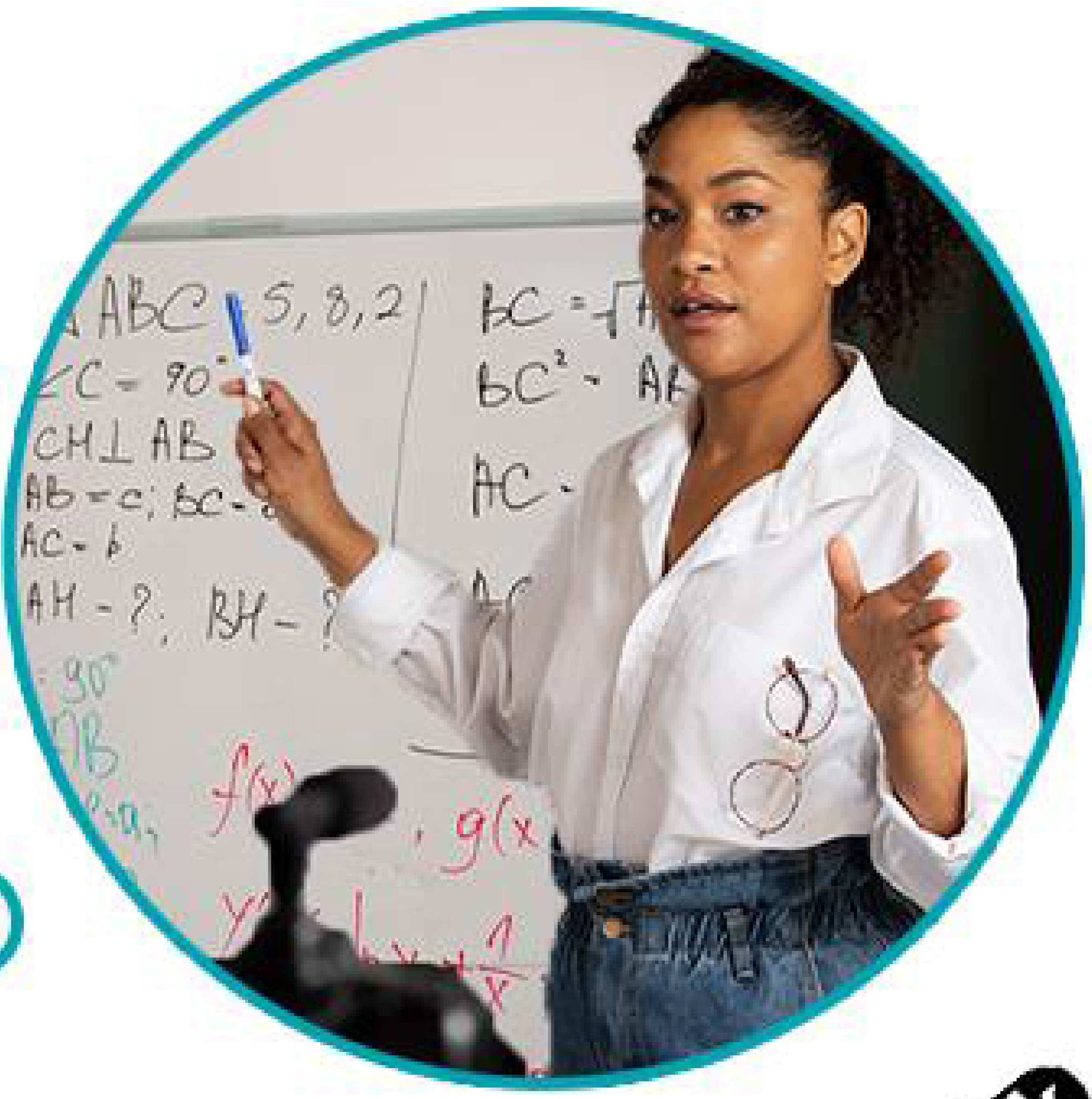
Primary



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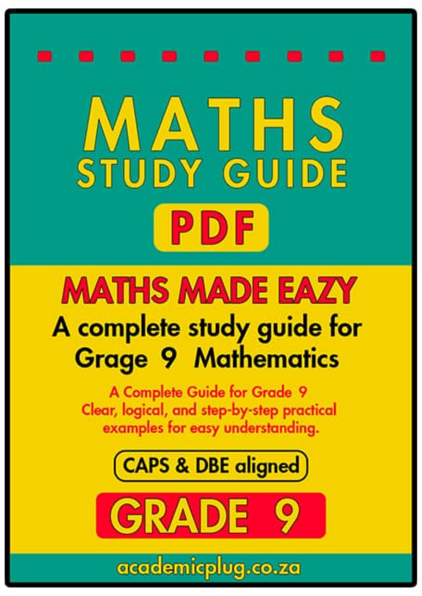

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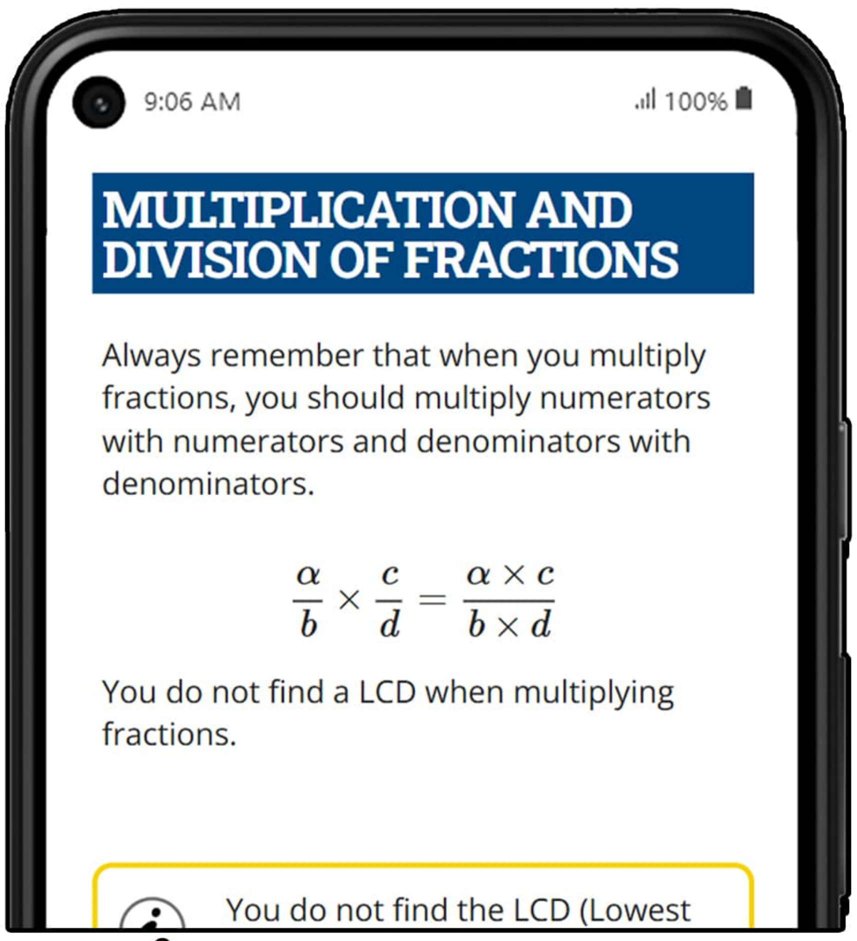

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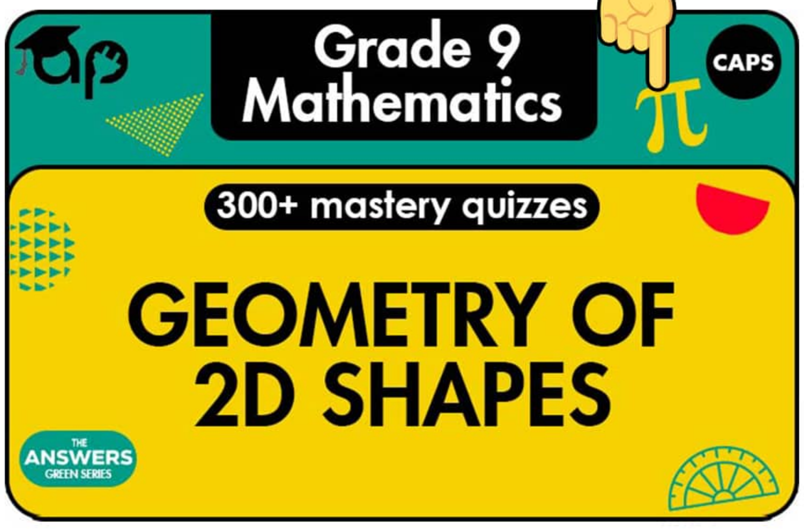

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CHAPTER 12
GEOMETRY OF 2D SHAPES

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
121	**A. Grade 8 Revision**	3.1	• Solve geometric problems involving unknown sides and angles in triangles and quadrilaterals, using known properties of triangles and quadrilaterals, as well as properties of congruent and similar triangles
121	• Types of Triangles		
121	• Notation used in Triangles		
122	• Properties of Triangles		
122	• Properties of Lines		
123	• Parallel Lines		
123	• The Theorem of Pythagoras		
126	• Quadrilaterals		
129	**B. Similarity and Congruency**		
129	• Similar Triangles		
133	• Congruent Triangles		
137	• Mixed Congruency Examples		

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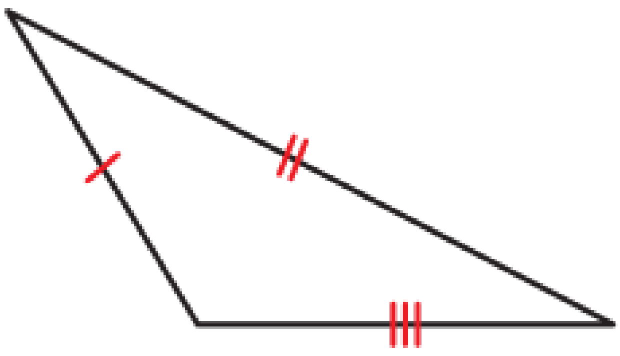
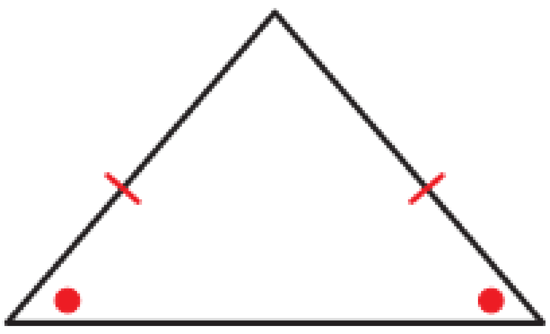
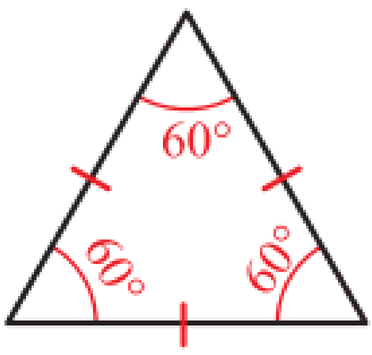
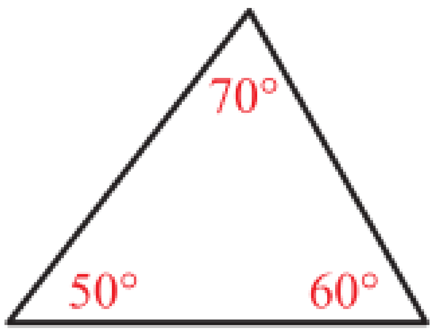
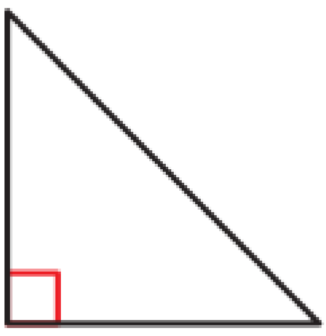
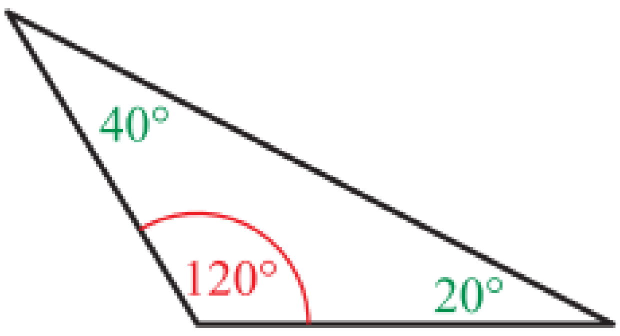
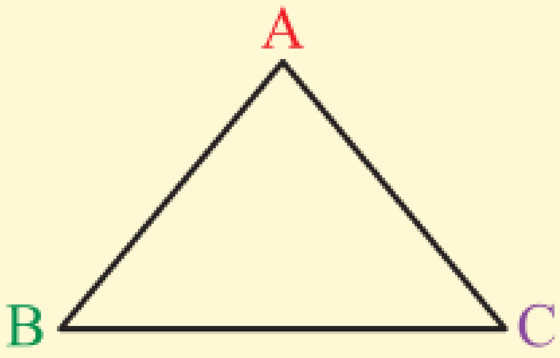
TYPES OF TRIANGLES

Property	Illustration	Explanation
Scalene		The sides of a **scalene** triangle are all **different lengths.** All of the **angles** in the **triangle are different**.
Isosceles		An **isosceles** triangle has **two sides** which are **equal in length**. The **angles** at the **base of the equal sides** are **equal**
Equilateral		All **three sides** of an equilateral triangle are **equal**. **Each angle** in the triangle is **equal to 60°**.
Acute		**All three angles** of the triangle are **acute**. **An acute angle is an angle greater than 0° and less than 90°.**
Right-Angled		**One angle** of the triangle is a **right angle**. **A right angle is an angle equal to 90°.**
Obtuse		**One angle** of the triangle is **obtuse**. The other two angles are acute. **An obtuse angle is an angle greater than 90° and less than 180°.**

When stating that the base angles in an isosceles triangle are equal, the reason used is ∠'s opp. = sides. For learners on the IEB curriculum isos. Δ is also an acceptable reason.

NOTATION USED IN TRIANGLES

Examine triangle ABC below:



The **angle** at vertex A is referred to as $\hat{A}$. It can also be written as $\mathbf{B\hat{A}C}$ **or** $\mathbf{C\hat{A}B}$.

The **angle** at vertex B is referred to as $\hat{B}$. It can also be written as $\mathbf{A\hat{B}C}$ **or** $\mathbf{C\hat{B}A}$.

The **angle** at vertex C is referred to as $\hat{C}$. It can also be written as $\mathbf{A\hat{C}B}$ **or** $\mathbf{B\hat{C}A}$.

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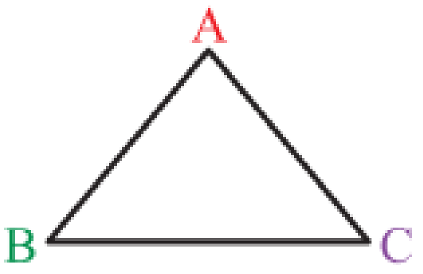
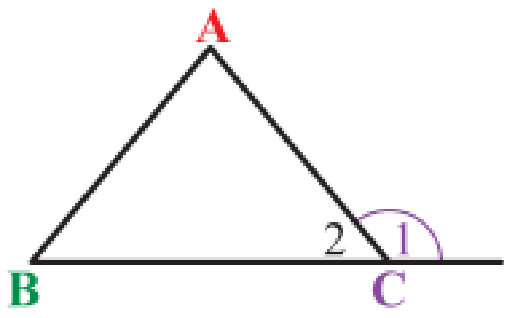
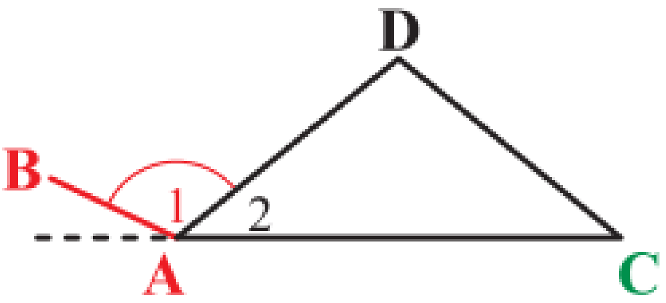
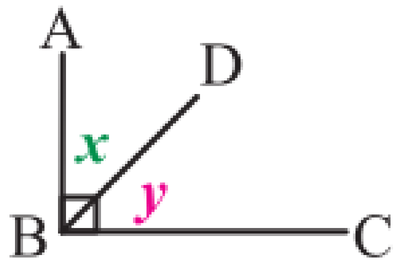
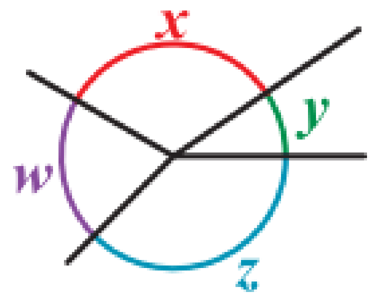
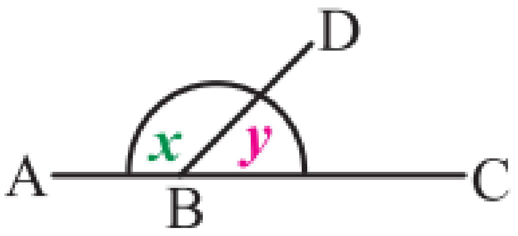
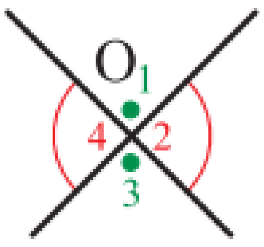
PROPERTIES OF TRIANGLES

Property	Illustration	Reason
The sum of the interior angles of a triangle is 180°.	 In triangle ABC: $\hat{A}+\hat{B}+\hat{C}=180^\circ$	∠'s in a △
The exterior angle of a triangle is equal to the sum of the interior opposite angles.	 In triangle ABC: $\hat{C}_1=\hat{A}+\hat{B}$	ext. ∠ of △

The exterior angle is formed by a straight line from one vertex of the triangle. Angle $\hat{A}_1$ below is **not** an exterior angle as line BAC is not a straight line.



PROPERTIES OF LINES

Property	Illustration	Reason
Complementary angles add up to 90°.	 In the above diagram: $x+y=90^\circ$	comp. ∠'s
The angles around a point add up to 360°.	 In the above diagram: $x+y+z+w=360^\circ$	∠'s around a pt.
Adjacent angles on a straight line are supplementary. Supplementary means adds up to 180°.	 In the above diagram: $x+y=180^\circ$	adj. ∠'s on a str. line
Vertically Opposite angles are equal	 In the above diagram: $\hat{O}_1=\hat{O}_3$ and $\hat{O}_2=\hat{O}_4$	vert. opp. ∠'s

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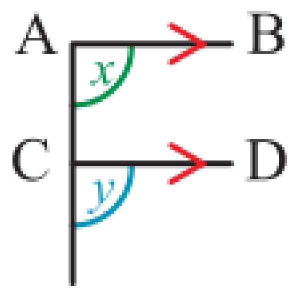
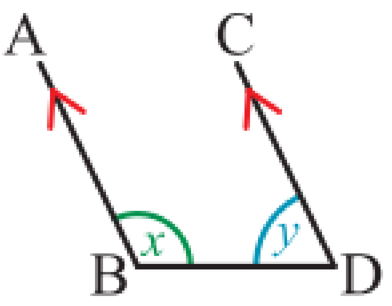
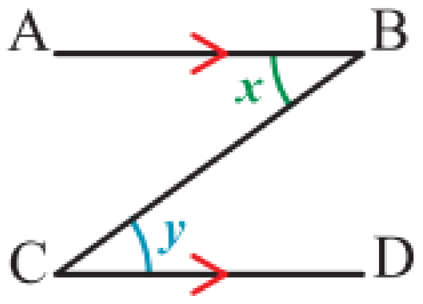
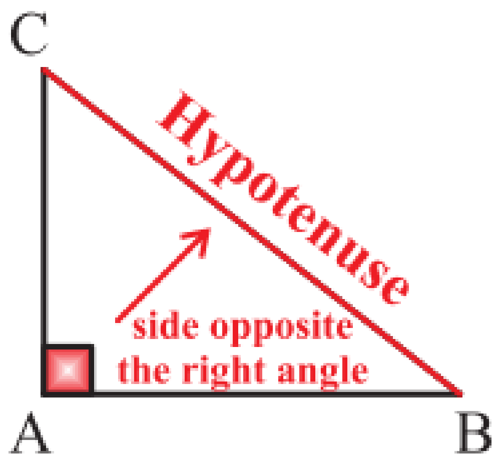
PARALLEL LINES

Property	Illustration	Reason
Corresponding Angles (F - Shape)	 $x = y$	corr. ∠'s (AB // CD)
Co-interior (U – Shape)	 $x + y = 180°$	co-int. ∠'s (AB // CD)
Alternate Angles (Z – Shape)	 $x = y$	alt ∠'s (AB // CD)

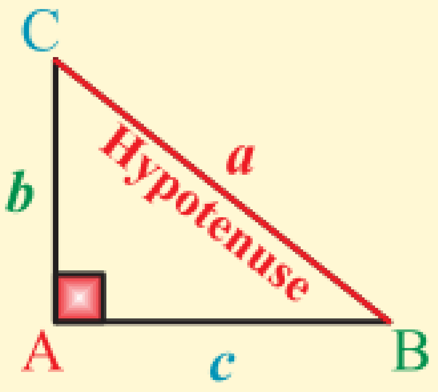
When using the properties of parallel lines, you must state the parallel lines you are using in your reason. The symbol for parallel is //.

THE THEOREM OF PYTHAGORAS

A **right-angled triangle** is a triangle which **contains a right angle**.
The **side opposite the right angle** is called the **hypotenuse**.
The **hypotenuse** is always the **longest side** of a right-angled triangle.



The Theorem of Pythagoras states that **the square of the hypotenuse is equal to the sum of the squares of the other two sides**.
This is shown mathematically below:

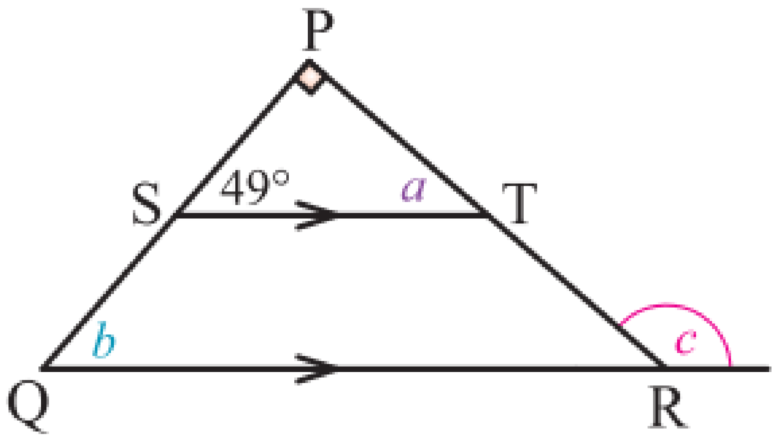


The Theorem of Pythagoras

$$a^2 = b^2 + c^2$$

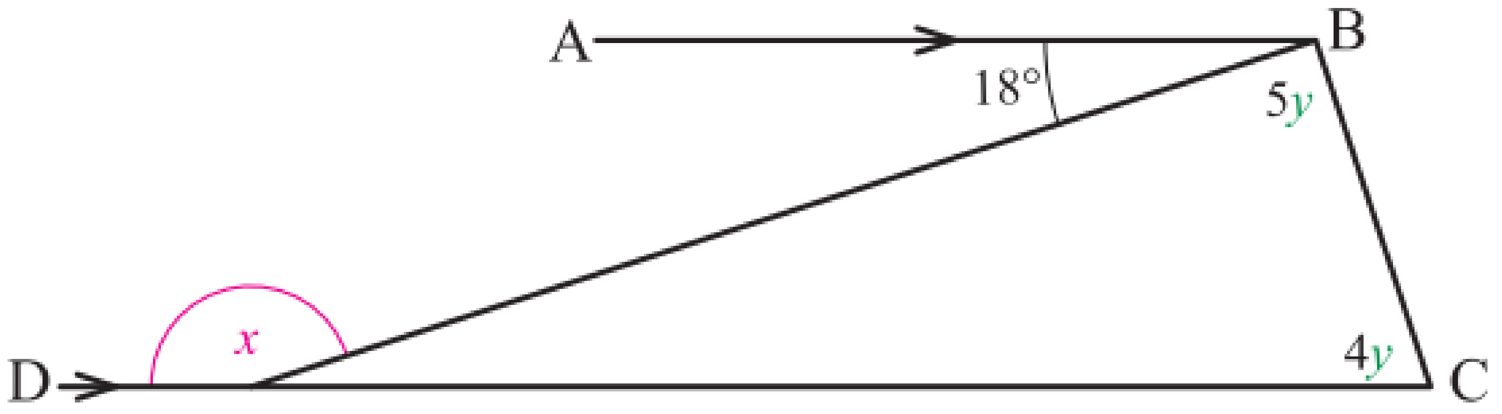
Reason: **Pythag.**

Example 1: Determine the value of a, b and c in the figure below:



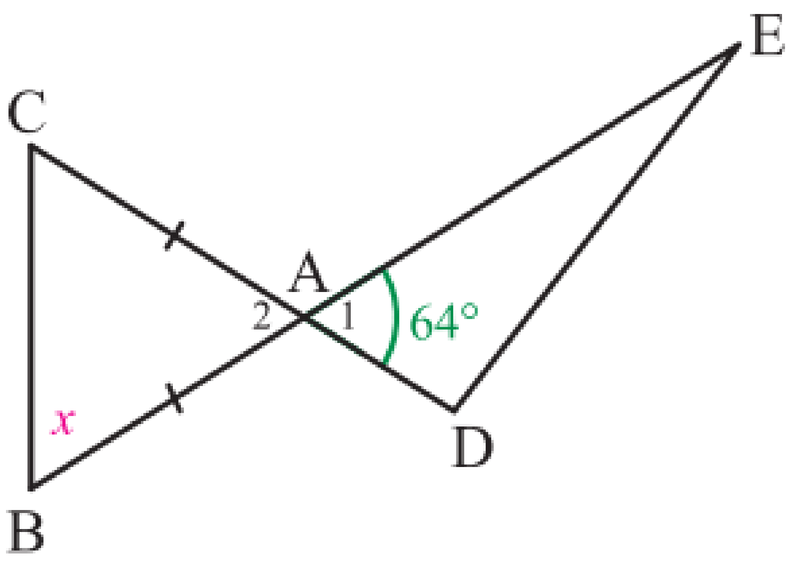
Statement	Reason
$a+90^\circ+49^\circ=180^\circ$	∠'s in Δ
$\therefore a=180^\circ-90^\circ-49^\circ$	
$\therefore a=41^\circ$	
$b=49^\circ$	corr. ∠'s (ST//QR)
$c=90^\circ+49^\circ$	ext. ∠ of Δ
$\therefore c=139^\circ$	

Example 2: Determine the value of x and y in figure below:



Statement	Reason
$x+18^\circ=180^\circ$	co-int. ∠'s (AB//DC)
$\therefore x=162^\circ$	
$4y+5y=x$	ext. ∠ of Δ
$\therefore 9y=162^\circ$ → divide both sides by 9	
$\therefore y=18^\circ$	

Example 3: Determine the value of x in the figure below:



Statement	Reason
$\hat{A}_2=\hat{A}_1=64^\circ$	vert. opp. ∠'s
$\hat{C}=\hat{B}=x$	∠'s opp. = sides
$\hat{C}+\hat{B}+\hat{A}_2=180^\circ$	∠'s in Δ
$x+x+64^\circ=180^\circ$	
$\therefore 2x=116^\circ$	
$\therefore x=58^\circ$	

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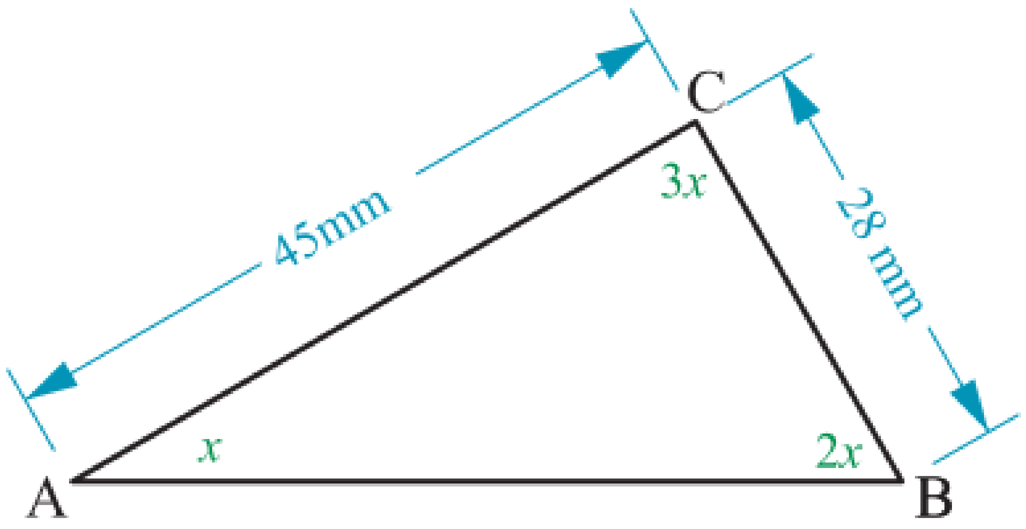
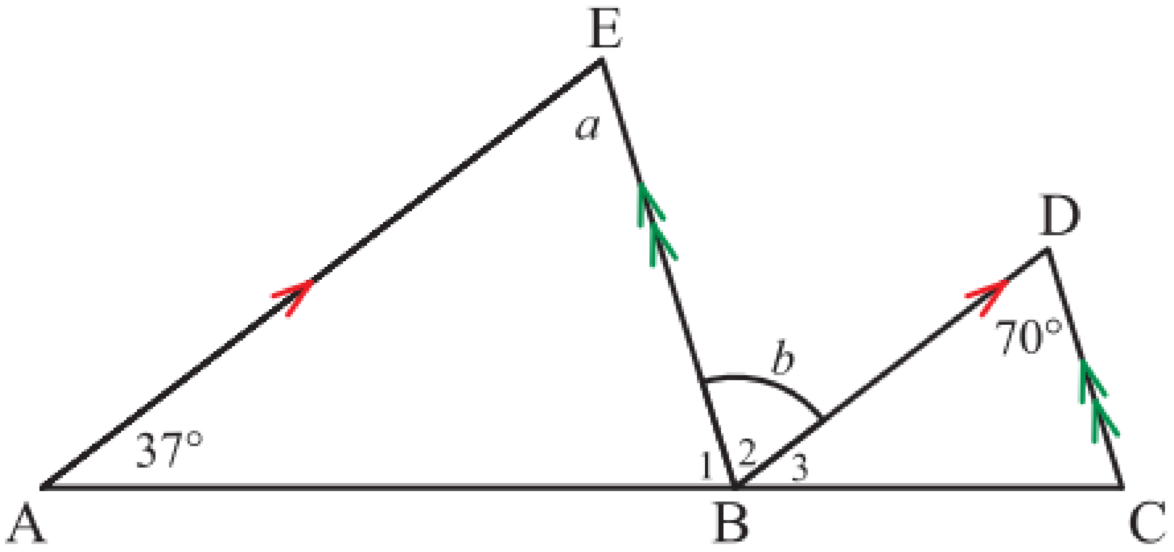
Example 4: **Determine the value of angle $A\hat{C}B$ and the length of AB in the figure below:**



Statement	Reason
$x+2x+3x=180^\circ$	∠'s in △
$\therefore 6x=180^\circ$	
$\therefore x=30^\circ$	
$\therefore A\hat{C}B=3\left(30^\circ\right)$	
$=90^\circ$	
$AB^2=AC^2+BC^2$	Pythag.
$=45^2+28^2$	
$=2809$	
$\therefore AB=\sqrt{2809}$	
$=53\,\text{mm}$	

Example 5: **Determine the value of angle *a* and *b* in the figure below:**

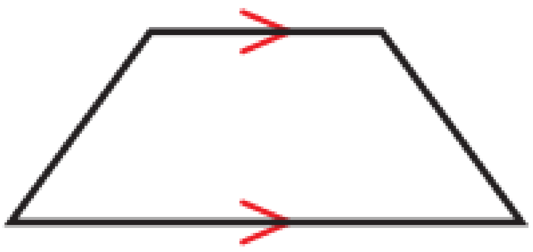
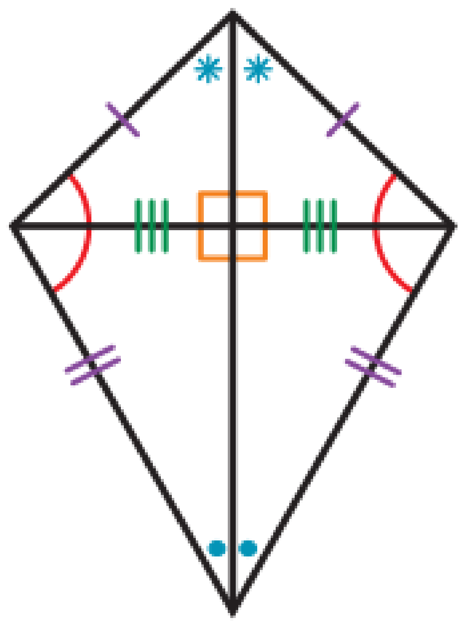
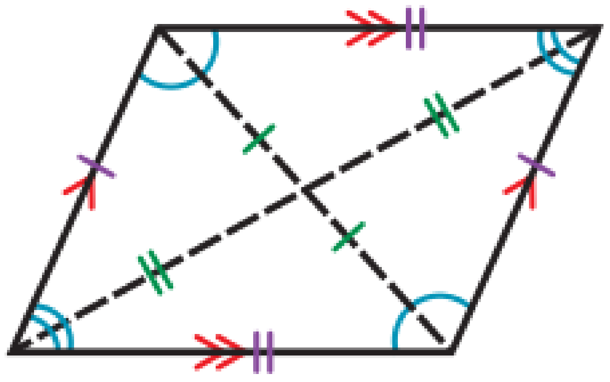
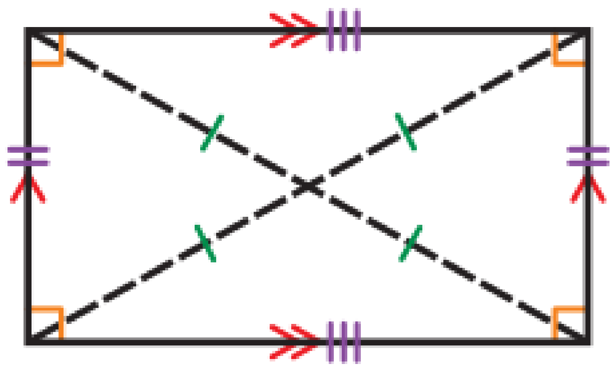
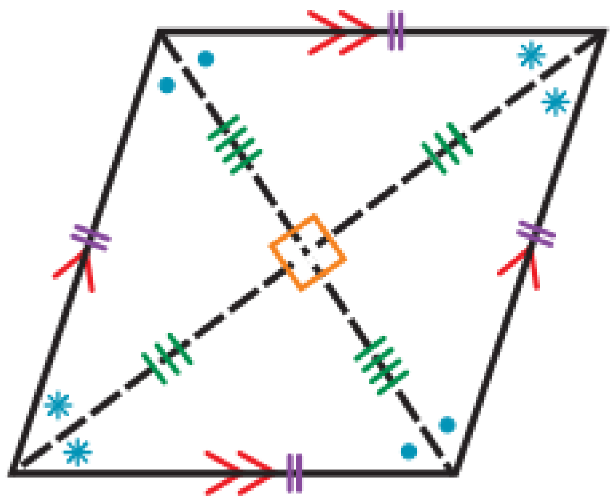
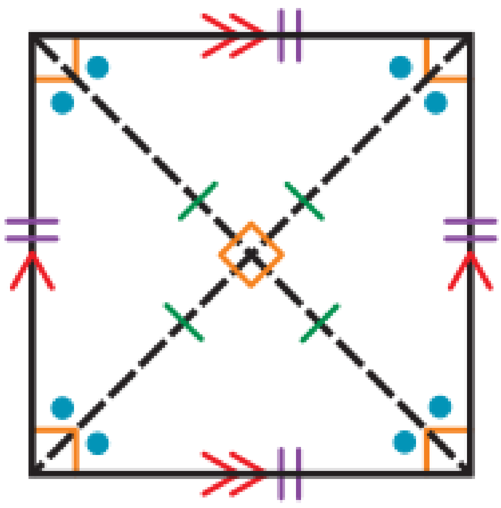


Statement	Reason
$b=70^\circ$	alt. ∠'s (EB//DC)
$a=b=70^\circ$	alt. ∠'s (AE//BD)

Complete Exercise 1 on page 322.

QUADRILATERALS

A quadrilateral is defined as a closed four-sided figure whose interior angles add up to 360º. The table below shows the quadrilaterals and their properties which you learnt in Grade 8.

Quadrilateral	Figure	Properties
Trapezium		• One pair of **opposite sides** are **parallel**
Kite		• Two pairs of **adjacent sides** are **equal** • A single pair of **opposite angles are equal** • Diagonals intersect each other at **90º** • The longer diagonal **bisects** the corner **angles** • The shorter diagonal is **bisected** by the longer diagonal
Parallelogram (parm)		• Both pairs of opposite sides are **parallel** and **equal** in length • Opposite angles are **equal** • **Diagonals bisect** each other
Rectangle		• Both pairs of opposite sides are **parallel** and **equal** in length • Corner **angles equal 90º** • **Diagonals** are **equal in length** and **bisect** each other
Rhombus		• All **sides** are **equal** in length • Opposite sides are **parallel** • Opposite angles are **equal** • **Diagonals bisect** each other at **90º**. • Diagonals bisect the corner **angles**
Square		• All four **sides** are **equal** in length • Opposite sides are **parallel** • Corner **angles** equal **90º** • Diagonals are **equal** and **bisect** each other at **90º** • Diagonals **bisect** the corner **angles**

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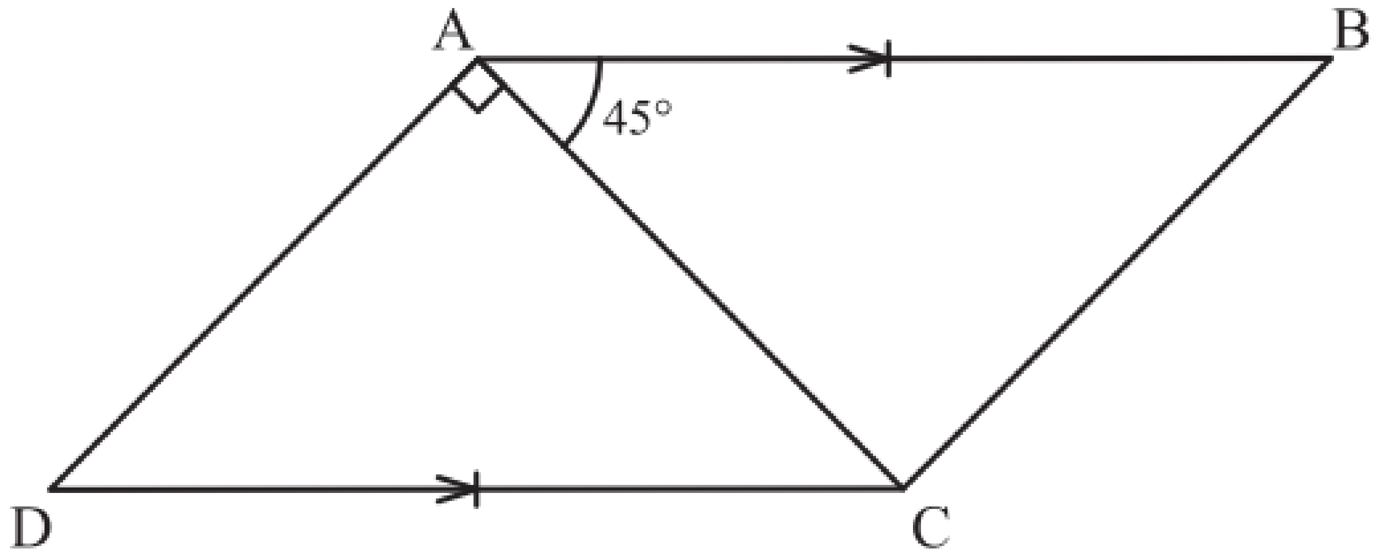
Example 1: **Examine the diagram below and answer the questions which follow.**



a) What type of shape is ABCD? Give a reason for your answer.

b) Complete the following statements:
The sum of angles in a quadrilateral add up to _____
Opposite angles of a parallelogram are ________

c) Determine the value of angle $\hat{C}$.

d) Determine the sum of angles $\hat{D}$ and $\hat{B}$.

e) Hence, determine the value of angle $\hat{B}$ and state which type of triangle ABC is.

	Statement	Reason
a)	ABCD is a parallelogram	one pair of opp. sides = and //

b) The sum of angles in a quadrilateral add up to **360°**.
Opposite angles of a parallelogram are **equal**.

	Statement	Reason
c)	$\hat{C} = \hat{A}$ $= 90^\circ + 45^\circ$ $= 135^\circ$	opp. ∠'s of a parm. are =
d)	$\hat{A} + \hat{C} + \hat{B} + \hat{D} = 360^\circ$ $\therefore 135^\circ + 135^\circ + \hat{B} + \hat{D} = 360^\circ$ $\therefore 270^\circ + \hat{B} + \hat{D} = 360^\circ$ $\therefore \hat{B} + \hat{D} = 360^\circ - 270^\circ$ $\therefore \hat{B} + \hat{D} = 90^\circ$	sum of ∠'s in a quadrilateral
e)	$\hat{B} = \hat{D}$ $\therefore \hat{B} = 90^\circ \div 2$ $= 45^\circ$	opp. ∠'s of a parm. are =
	∴ ABC is an isosceles triangle	∠'s at base of Δ are =

If a quadrilateral has any one of the following properties it is a parallelogram:

- **Both pairs of opposite sides parallel.**
- **Both pairs of opposite sides equal.**
- **Both pairs of opposite angles equal.**
- **One pair of opposite sides equal and parallel.**
- **Diagonals bisect each other (have the same midpoint).**

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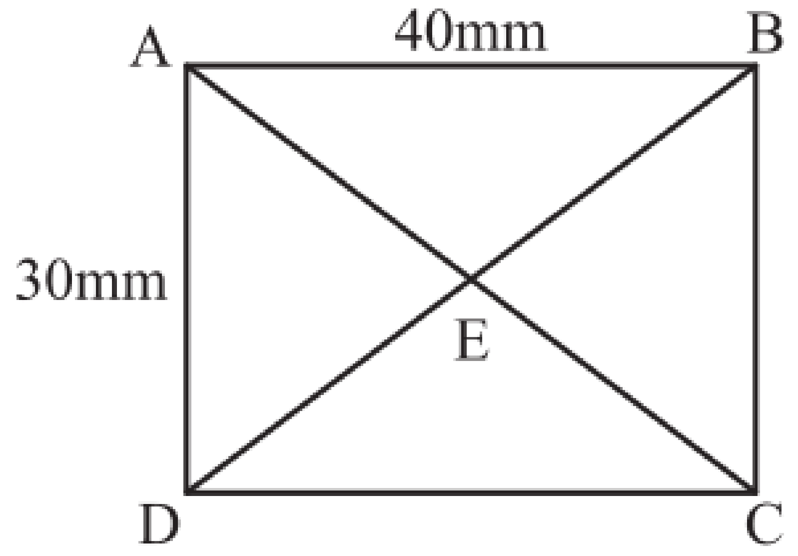
Example 2: **In the diagram below quadrilateral ABCD is a rectangle.**



a) **What is the length of BC and CD?**

b) **What is the size of angle $D\hat{C}B$?**

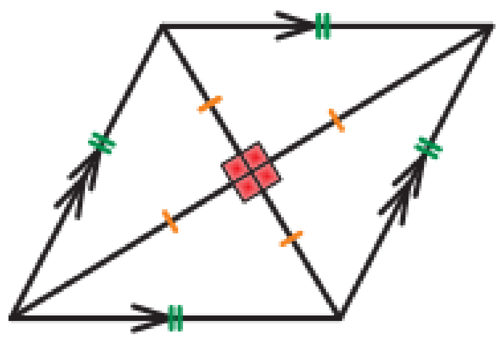
c) **Determine the length of BD.**

Hint: think about your answer in b) to solve this problem.

d) **What is the length DE?**

	Statement	Reason
a)	BC = 30mm CD = 40mm	opp. sides of a rect. are = opp. sides of a rect. are =
b)	$D\hat{C}B = 90^\circ$	corner ∠'s of a rect. = 90°
c)	$BD^2 = CD^2 + BC^2$ $= 40^2 + 30^2$ $= 2500 \rightarrow$ this is BD^2 $\therefore BD = 50\text{ mm} \rightarrow \sqrt{2500} = 50$	Pythag.
d)	$DE = \frac{1}{2}BD$ $= \frac{1}{2}(50)$ $= 25\text{ mm}$	diags of rect. bisect each other

Example 3: **Mrs Nkosi placed the shape below on her board and asked two learners what the shape was.**



James answered that it was a parallelogram because opposite sides are equal and parallel. Zaheera answered that the shape was a rhombus as the diagonals bisect each other at 90°. Mrs Nkosi replied that although James was correct, Zaheera was the most correct and provided the answer she wanted. Explain Mrs Nkosi's answer.

A rhombus is a special type of parallelogram. It has all the properties of a parm. However, in addition to having all the properties of a parm, its diagonals also bisect each other at 90°. A rectangle, rhombus and square are all parallelograms with additional properties.

Complete Exercise 2 on pages 322 and 323.

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B. SIMILARITY AND CONGRUENCY

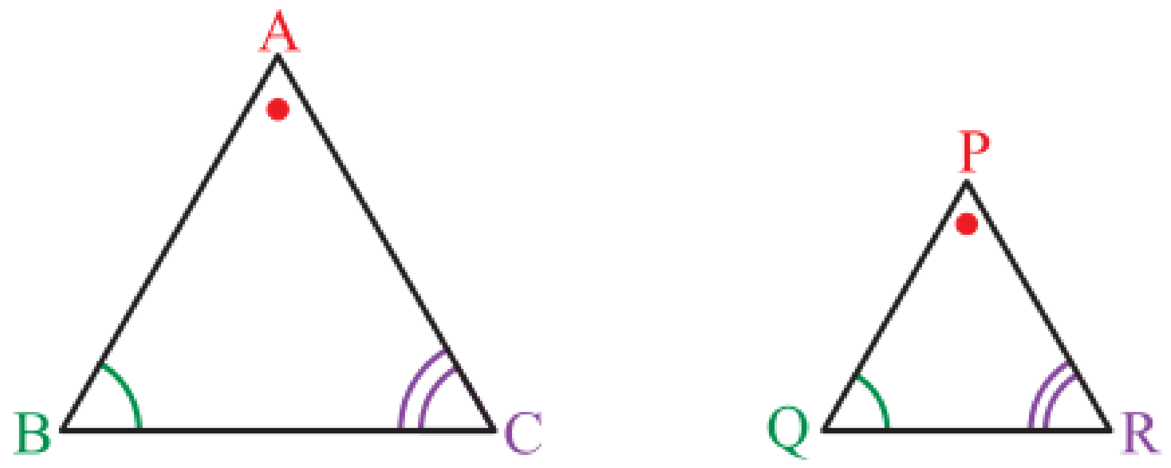
You were first introduced to similarity and congruency in Grade 8. In Grade 9 you will learn more about these topics specifically relating to triangles.

SIMILAR TRIANGLES

If two triangles are similar, then:
1) Their **corresponding angles** are **equal**.
2) Their **corresponding sides** are **in proportion**.

The symbol for similarity is /// or |||.

Illustrative Example 1: Examine the triangles shown below. In the diagrams, △ABC /// △PQR.



The order in which **△ABC /// △PQR** is written is very important. The **order of the letters** on either side of the /// sign **tells us which angles are equal** and **which sides are in proportion**.

From the order in which the triangles are written, △ABC /// △PQR we can see that:

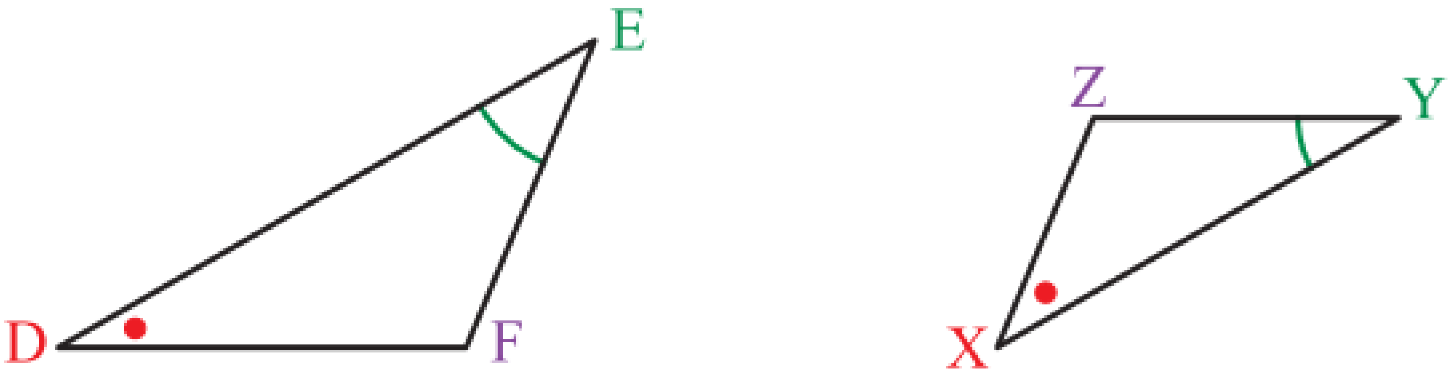
$\hat{A} = \hat{P}$
$\hat{B} = \hat{Q}$ **and** $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$ **or** $\frac{PQ}{AB} = \frac{QR}{BC} = \frac{PR}{AC}$
$\hat{C} = \hat{R}$

There are two ways to prove that triangles are similar:
1) Prove that the corresponding angles of the triangles are equal.
2) Prove that the corresponding sides of the triangles are in proportion.

The third angle of a triangle:
The interior angles of a triangle sum to 180°.
This means that in any two triangles, if two angles are equal the 3rd angle of each triangle are equal.

In other words,
In the above diagram if $\hat{A} = \hat{P}$ and $\hat{B} = \hat{Q}$ then $\hat{C} = \hat{R}$.
This means that if you are proving triangles are similar, you only need to prove that two angles in each triangle are equal as the 3rd angles will always be equal.

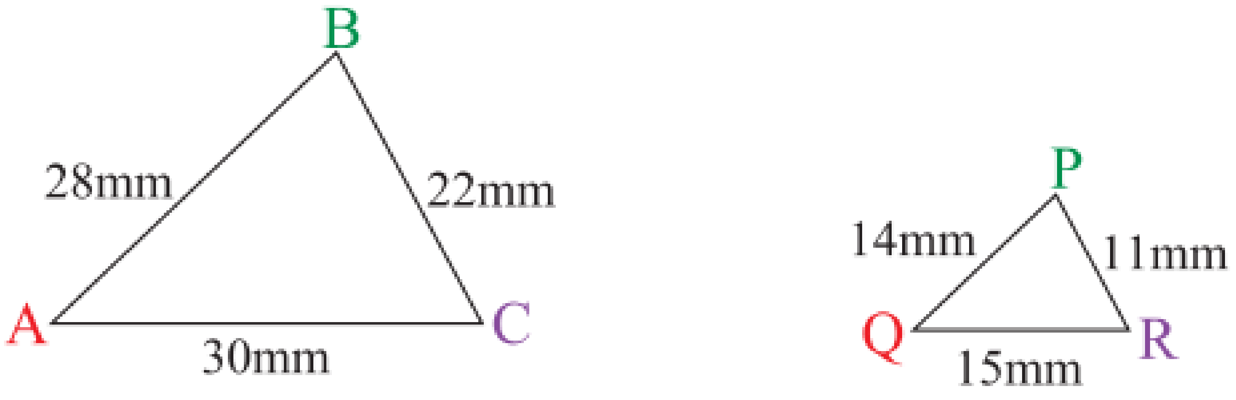
Illustrative Example 2: **Examine the triangles shown below. In the diagrams, $\hat{D} = \hat{X}$ and $\hat{E} = \hat{Y}$. Prove that the triangles are similar.**



Statement	Reason
In $\triangle DEF$ and $\triangle XYZ$	
$\hat{D} = \hat{X}$	given
$\hat{E} = \hat{Y}$	given
$\hat{F} = \hat{Z}$	3rd $\angle$ of $\triangle$
$\therefore \triangle DEF \;///\; \triangle XYZ$	A.A.A
$\therefore \frac{DE}{XY} = \frac{EF}{YZ} = \frac{DF}{XZ}$	sim. $\triangle$'s

If you are proving triangles are similar using their angles, the reason used is Angle, Angle, Angle which is abbreviated to A.A.A.

Illustrative Example 3: **In the diagram below the dimensions of each side of the triangles are as shown on the diagram. Prove that the triangles are similar.**



As you are given the length of each side you must prove that the corresponding sides of the triangles are in proportion.

Statement	Reason
In $\triangle ABC$ and $\triangle QPR$	
$\frac{AC}{QR} = \frac{30}{15} \rightarrow \frac{\text{longest side of ABC}}{\text{longest side of PQR}}$	
$= 2$	
$\frac{AB}{QP} = \frac{28}{14} \rightarrow \frac{2^{nd}\text{ longest side of ABC}}{2^{nd}\text{ longest side of PQR}}$	
$= 2$	
$\frac{BC}{PR} = \frac{22}{11} \rightarrow \frac{\text{shortest side of ABC}}{\text{shortest side of PQR}}$	
$= 2$	
$\therefore \frac{AC}{QR} = \frac{AB}{QP} = \frac{BC}{PR} = 2$	
$\therefore \triangle ABC \;///\; \triangle QPR$	sides in prop.

If you are proving triangles are similar using their sides, the reason used is sides in proportion which is abbreviated to sides in prop.

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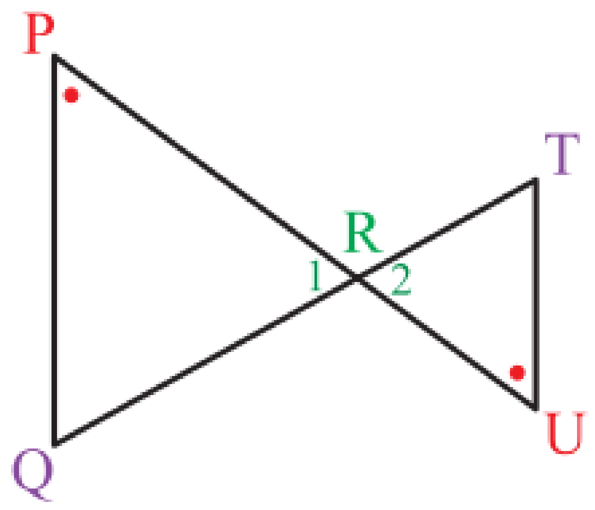
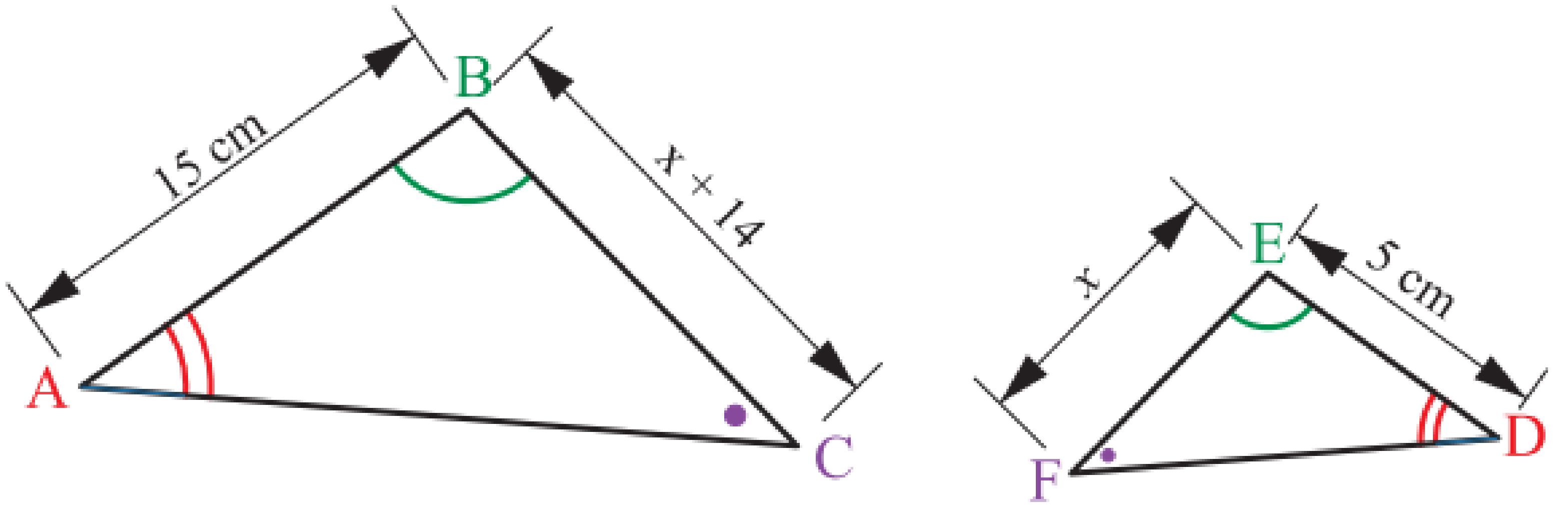
Example 1: **In the diagram below $\hat{P} = \hat{U}$. Prove that ΔPRQ /// ΔURT.**



Statement	Reason
In ΔPRQ and ΔURT	
$\hat{P} = \hat{U}$	given
$\hat{R}_1 = \hat{R}_2$	vert. opp. ∠'s
$\hat{Q} = \hat{T}$	3rd ∠ of Δ
$\therefore$ **ΔPRQ /// ΔURT**	A.A.A
$\therefore \frac{PR}{UR} = \frac{RQ}{RT} = \frac{PQ}{UT}$	sim. Δ's

It is good practice to write down the ratios of sides of similar triangles, even if you are not calculating the length of the sides of the triangles.

Example 2: **In the diagram below ΔABC /// ΔDEF. Determine the length of BC.**



Statement	Reason
In ΔABC and ΔDEF	
$\therefore \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$	sim. Δ's
$\therefore \frac{x+14}{x} = \frac{15}{5} \rightarrow \frac{BC}{EF} = \frac{AB}{DE} \rightarrow \text{LCD} = 5x$	
$\therefore 5(x+14) = 15x \rightarrow$ distribute the 5	
$\therefore 5x + 70 = 15x$	
$\therefore -10x = -70 \rightarrow$ divide both sides by -10	
$\therefore x = 7\text{cm}$	
$\therefore \text{EF} = 7\text{ cm}$	
$\therefore \text{BC} = 7 + 14$	
$= 21\text{cm}$	

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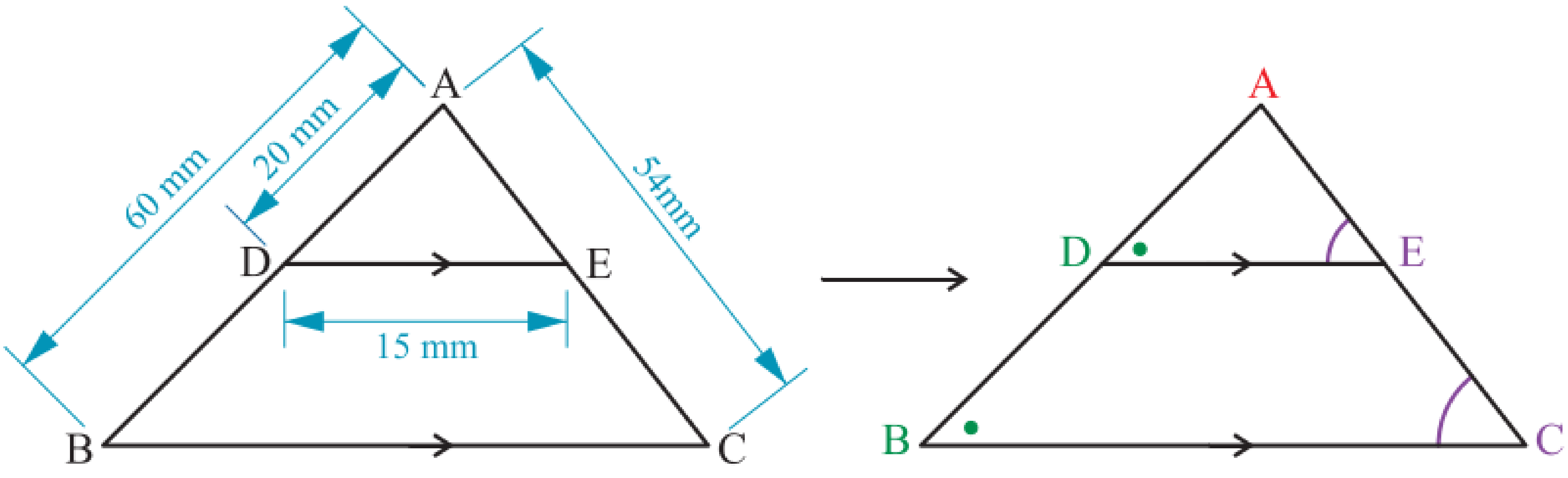
Example 3: **Examine the triangle below on the left. AB = 60mm, AD = 20mm, AC = 54mm and DE = 15mm. DE // BC.**

a) Prove that $\triangle ABC \,///\, \triangle ADE$.

b) Hence, determine the length of BC and AE.



	Statement	Reason
a)	In $\triangle ABC$ and $\triangle ADE$	
	$\hat{A} = \hat{A}$	common ∠
	$\hat{B} = \hat{D}$	corr. ∠'s (DE // BC)
	$\hat{C} = \hat{E}$	3rd ∠ of Δ **or** corr. ∠'s (DE // BC)
	$\therefore \triangle ABC \,///\, \triangle ADE$	A.A.A
	$\therefore \frac{AB}{AD} = \frac{BC}{DE} = \frac{AC}{AE}$	sim. Δ's
b)	$\frac{BC}{DE} = \frac{AB}{AD}$	sim. Δ's
	$\therefore \frac{BC}{15} = \frac{60}{20}$ → multiply both sides by 15	
	$\therefore BC = \frac{60}{20} \times 15$	
	$\therefore BC = 45\,\text{mm}$	
	$\therefore \frac{AE}{AC} = \frac{AD}{AB}$	sim. Δ's
	$\therefore \frac{AE}{54} = \frac{20}{60}$ → multiply both sides by 54	
	$\therefore AE = \frac{20}{60} \times 54$	
	$= 18\,\text{mm}$	

When solving for a side using the proportion of similar triangles, place the side you are solving for on top (as the numerator).

Complete Exercise 3 on page 324.

CONGRUENT TRIANGLES

In the previous chapter you were introduced to the four cases required for two triangles to be congruent.

There are **4 conditions for two triangles to be congruent**.
If **any** of the 4 conditions are **satisfied the triangles are congruent**.
The 4 conditions under which triangles are congruent are:

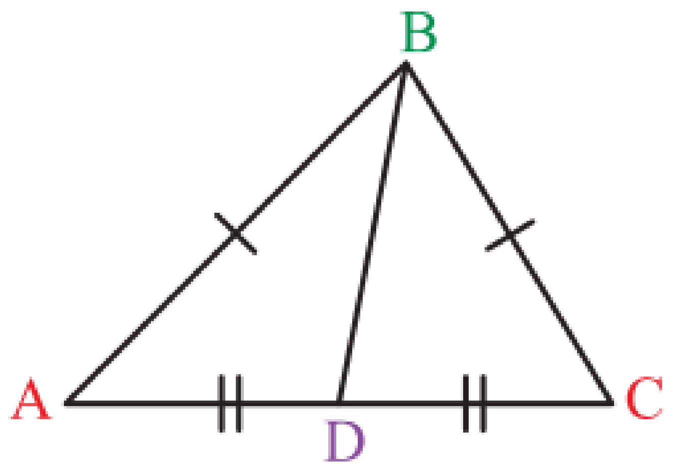
1) **Side, Side Side (SSS)**
2) **Side, Angle, Side (SAS)**
3) **Angle, Angle, Side (AAS)**
4) **Right Angle, Hypotenuse, Side (RHS)**

1) Side, Side, Side (SSS)

If all of the **corresponding sides** of two triangles are **equal**, the **triangles are congruent**.

If two triangles are congruent the triangles are the same. This means that each corresponding side and angle of the triangles are equal.
The symbol for congruency is ≡.

<u>Example</u>: **△ABD and △CBD are shown below, prove that △ABD ≡ △CBD given that AB = BC and AD = CD.**



Statement	Reason
In △ABD and △CBD	
AB = CB → side	given
AD = CD → side	given
BD = BD → side	common side
∴ △ABD ≡ △CBD	S.S.S

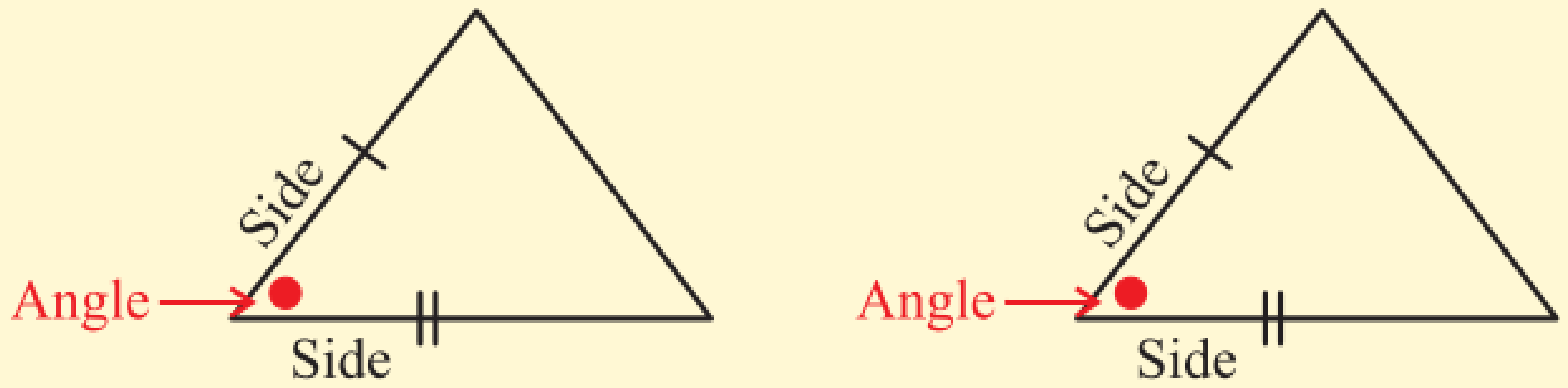
As with similarity if it is written △ABC ≡ △CDE, the sides that are equal can be read from the order the triangles are written in:

△ABC ≡ △CDE

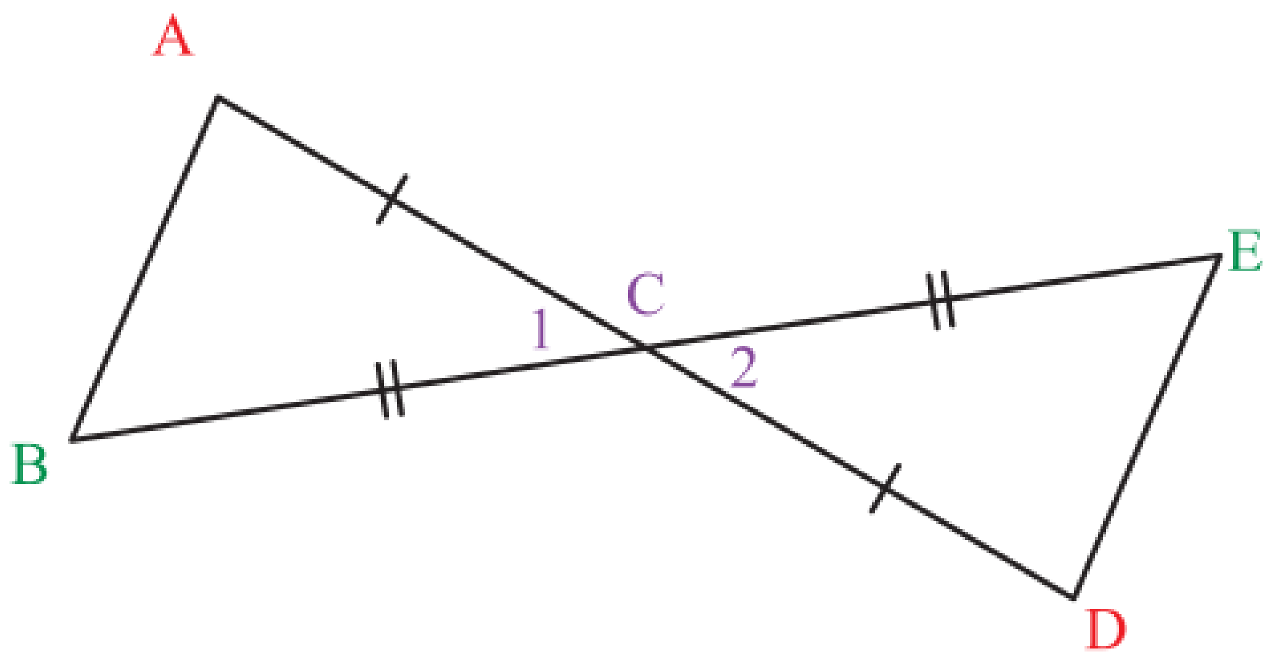
AB = CD and BC = DE and AC = CE

2) Side, Angle, Side (SAS)

If **two sides and the angle between the two sides** of two triangles are **equal**, the **triangles are congruent**.



Example: **ΔABC and ΔDEC are shown below, prove that $\Delta ABC \equiv \Delta DEC$ given that AC = DC and BC = CE.**



Statement	Reason
In ΔABC and ΔDEC	
AC = DC $\rightarrow$ side	given
$\hat{C}_1 = \hat{C}_2 \rightarrow$ angle	vert. opp. ∠'s
EC = BC $\rightarrow$ side	given
$\therefore \Delta ABC \equiv \Delta DEC$	S.A.S

When using S.A.S to prove congruency, the angle must be between the two sides which are equal. The triangle pairs shown below are not congruent as the equal angles are not between the two equal sides in both triangles.

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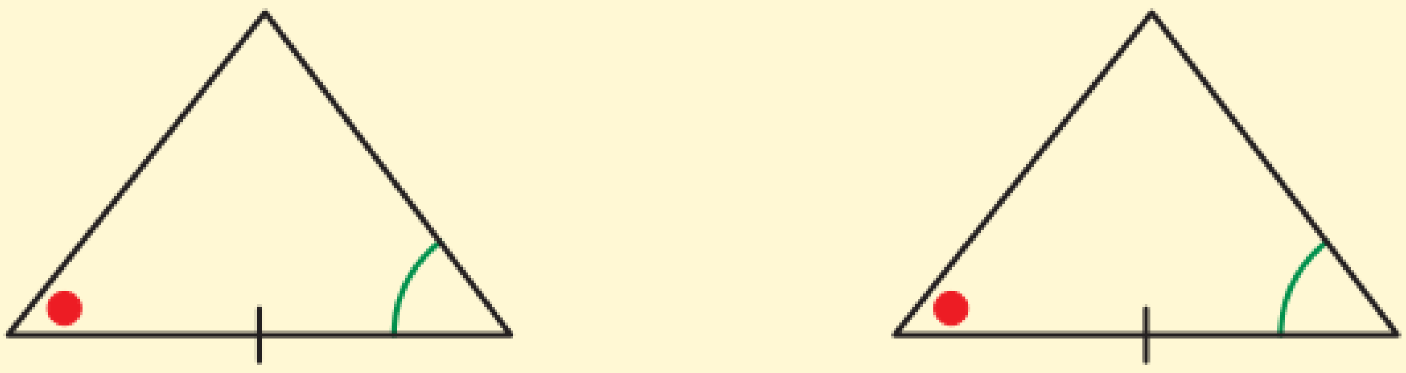
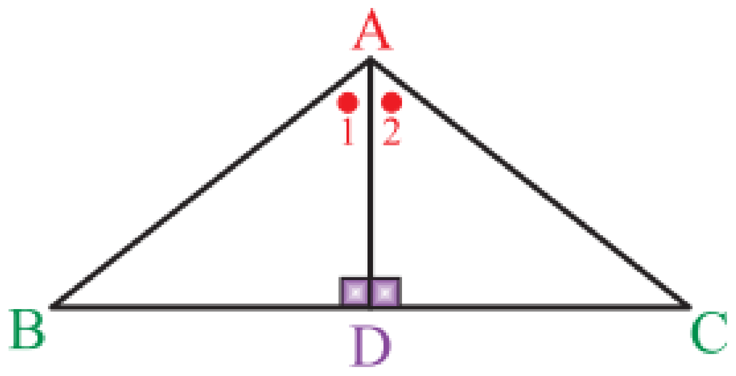
3) Angle, Angle, Side (AAS)
Side, Angle, Angle (SAA)
Angle, Side, Angle (ASA)

If **two angles and a corresponding side** of two triangles are **equal**, the **triangles are congruent**.

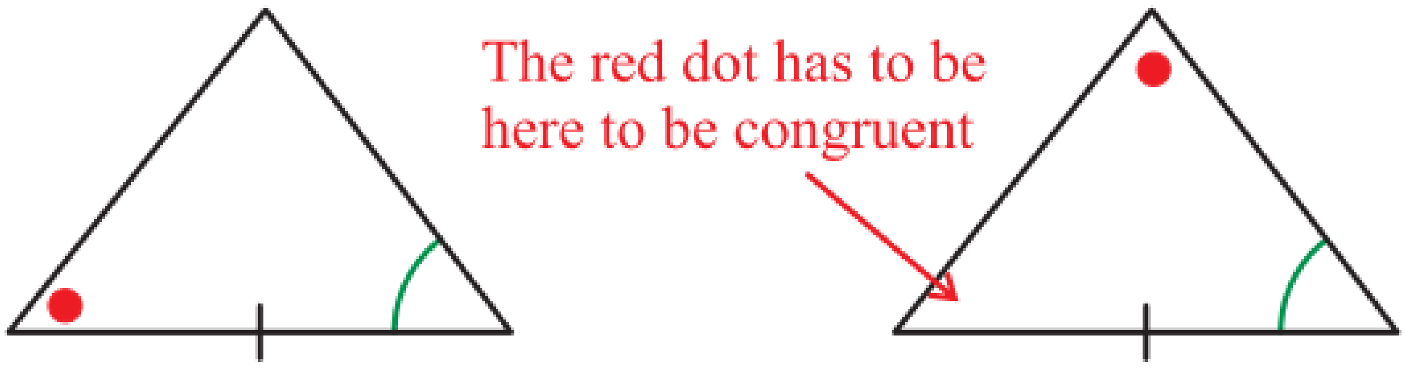


Example: **In ΔABD and ΔACD shown below $\hat{A}_1 = \hat{A}_2$. If AD is perpendicular to BC, prove that $\Delta ADB \equiv \Delta ADC$**

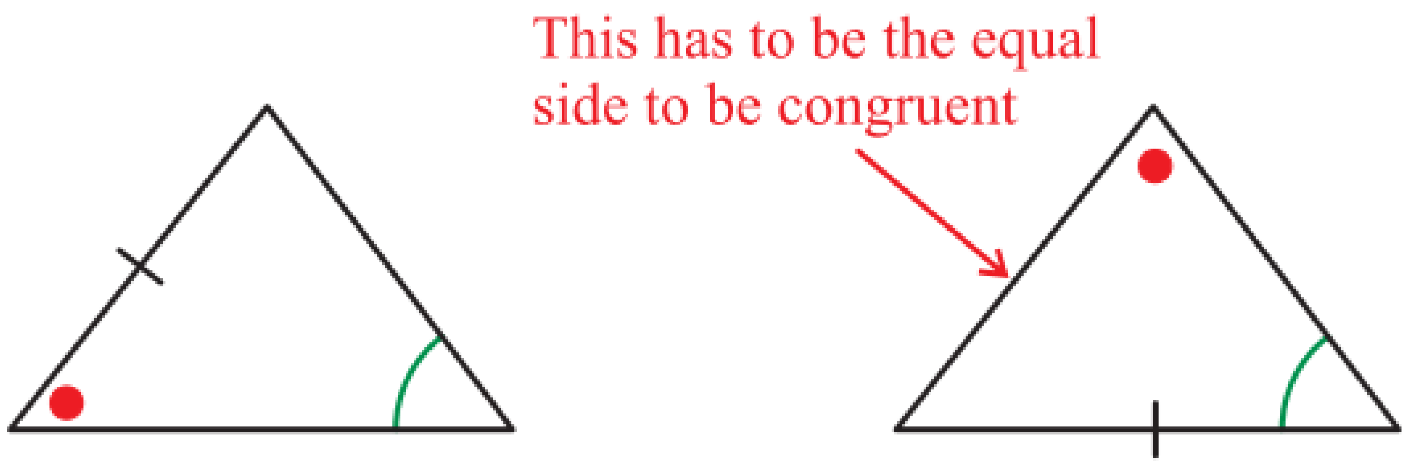


Statement	Reason
In ΔABD and ΔACD	
$\hat{A}_1 = \hat{A}_2 \rightarrow$ angle	given
$\hat{D} = \hat{D} \rightarrow$ angle	given ($AD \perp BC$)
$AD = AD \rightarrow$ side	common side
$\therefore \Delta ABD \equiv \Delta ACD$	A.A.S

When using A.A.S to prove congruency the angles must be in the same place relative to the equal side. The triangle pair shown below are not congruent because in the first triangle, the equal side is between the red angle, and green angle, whilst in the second triangle the equal side is between the green angle and the angle not shown.



The triangle pair shown below are not congruent because in the first triangle the equal side is between the angle not shown and the red dot whilst in the second triangle the equal side is between the angle not shown and the green angle.



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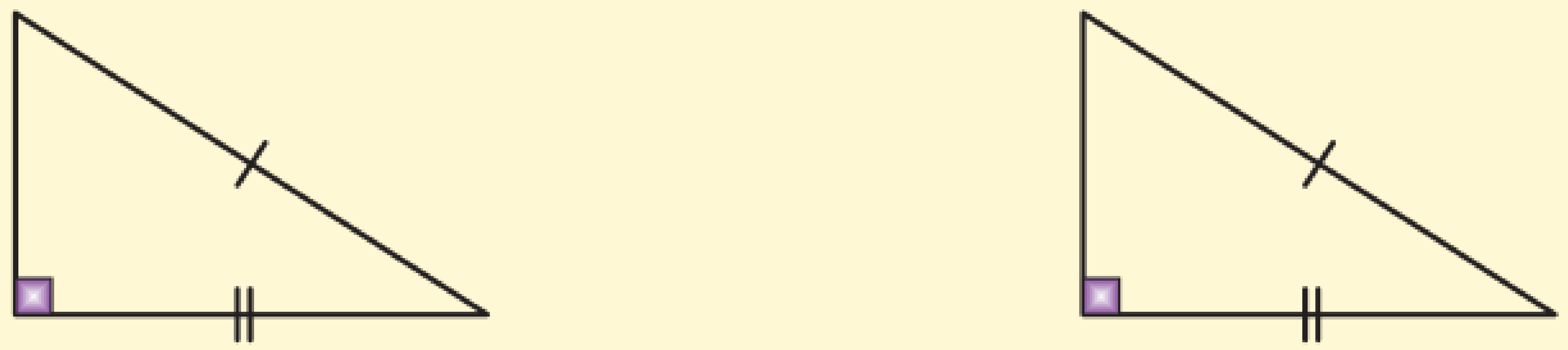
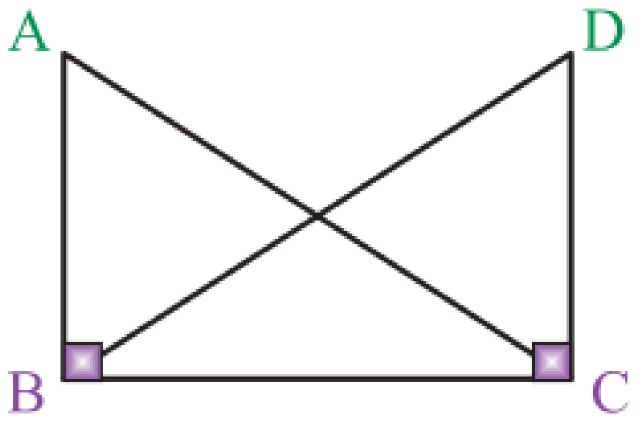
4) Right angle, Hypotenuse, Side

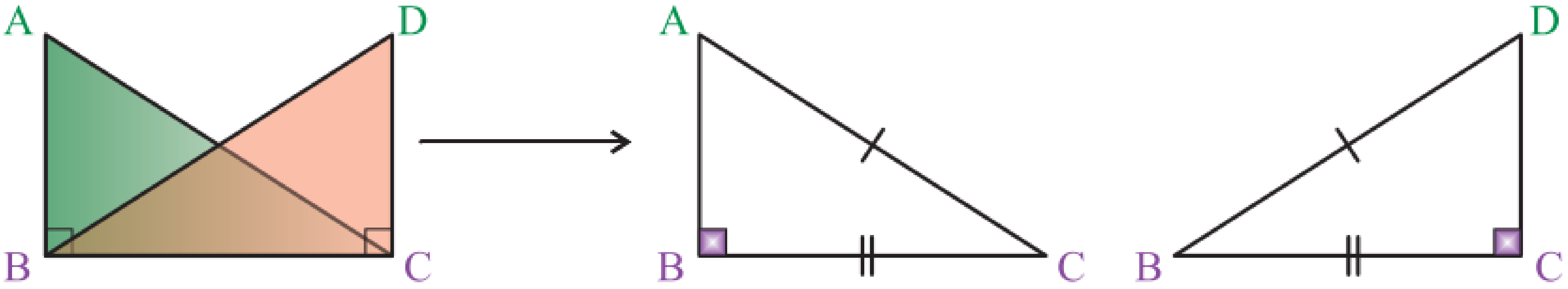
If two **right-angled triangles** have an **equal side** and their **hypotenuses are equal** the **triangles are congruent**.



__Example__: **In $\triangle ABC$ and $\triangle DCB$ shown below AC = DB. If AB and DC are perpendicular to BC, prove that $\triangle ABC \equiv \triangle DCB$**



Before starting this example, it is important to identify the two triangles you are working in. Note that the triangles share a common side BC.



Statement	Reason
In $\triangle ABC$ and $\triangle DCB$	
$\hat{B} = \hat{C} = 90^\circ$ → right angle	given ($AB \perp BC$ and $DC \perp BC$)
AC = DB → hypotenuse	given
BC = BC → side	common side
$\therefore \triangle ABC \equiv \triangle DCB$	R.H.S

As you can see by the example on the previous page, if a triangle has a right angle in it, you do not have to use RHS to prove congruency.
To use RHS you must have an equal hypotenuse and one other side in a right-angled triangle. The hypotenuse is always opposite the right angle.

Complete Exercise 4 number 1 on page 325

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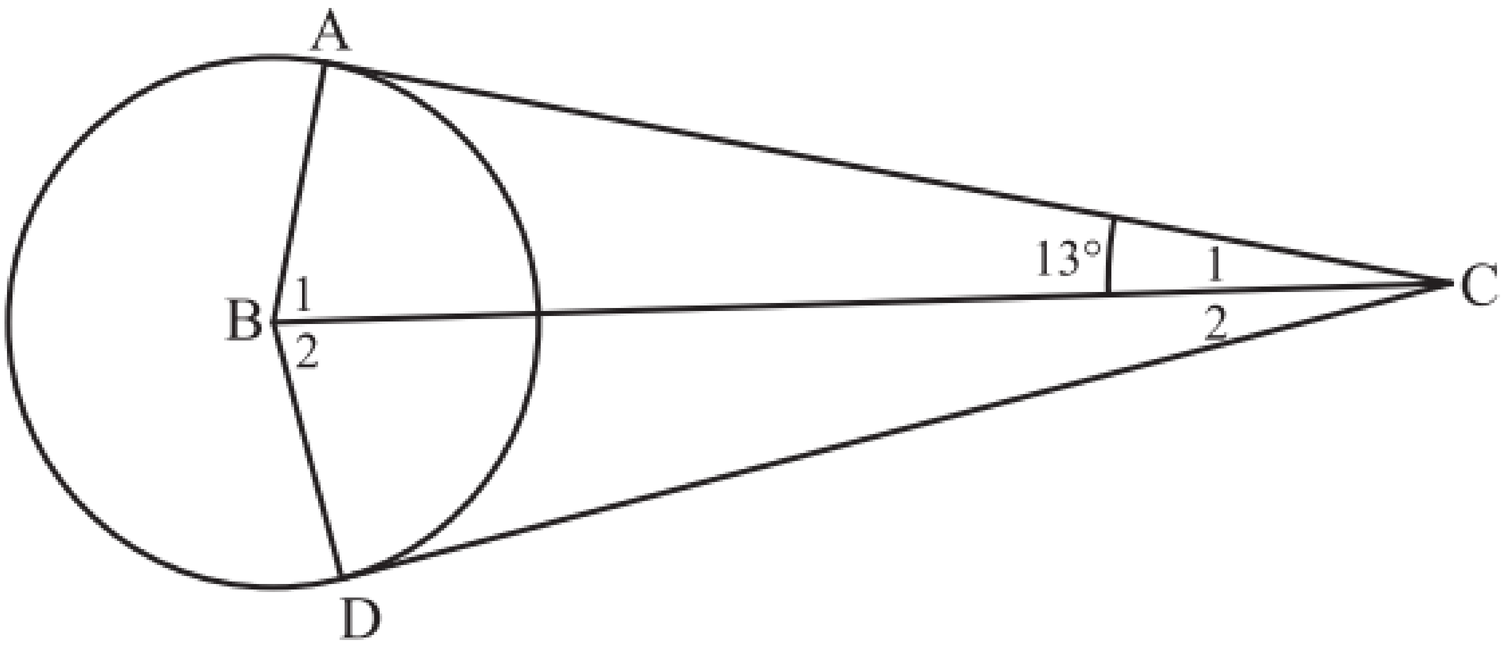
MIXED CONGRUENCY EXAMPLES

Example 1: In the diagram below B is the centre of the circle and $\hat{B}_1 = \hat{B}_2$.

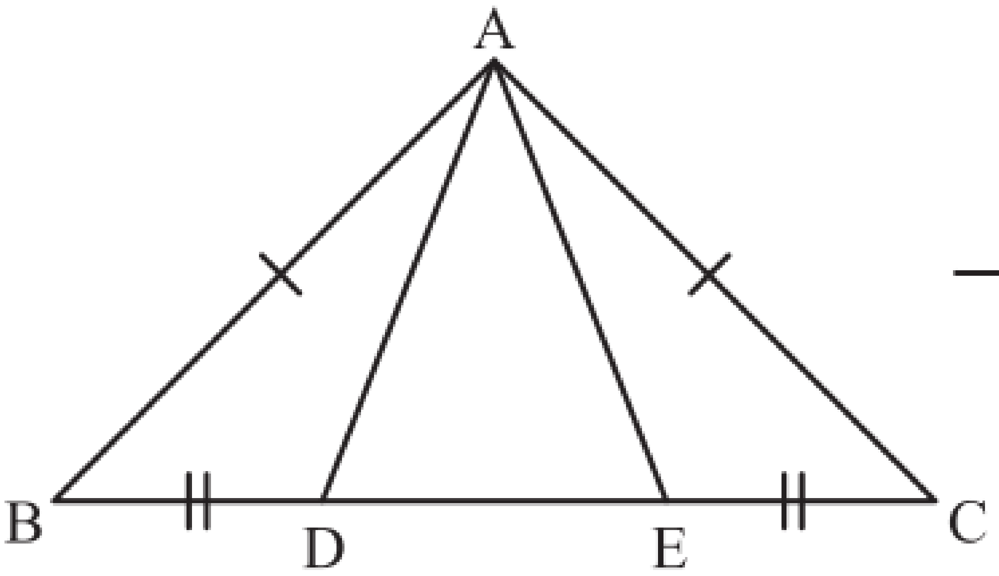
a) Prove that $\Delta ABC \equiv \Delta DBC$.

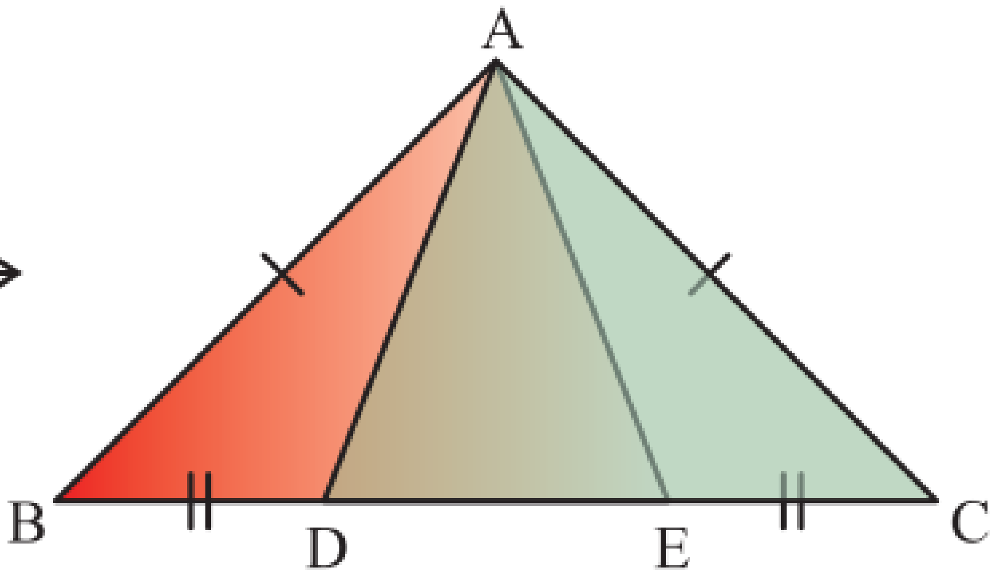
b) If $\hat{C}_1 = 13°$, what is the size of $\hat{C}_2$?



	Statement	Reason
a)	In ΔABC and ΔDBC	
	$AB = BD \rightarrow$ side	radii
	$\hat{B}_1 = \hat{B}_2 \rightarrow$ angle	given
	$BC = BC \rightarrow$ side	given
	$\therefore \Delta ABC \equiv \Delta DBC$	S.A.S
b)	$\hat{C}_1 = \hat{C}_2$	congruent Δ's
	$\therefore \hat{C}_2 = 13°$	

Example 2: Given that AB = AC and BD = CE, prove that $\Delta ABE \equiv \Delta ACD$.





Before starting this problem, note that DE is common to both triangles which you are proving congruent. Also, note that **BE** = **BD** + **DE** and **CD** = **CE** + **DE**
However, it was given that **BD = CE**. Therefore **BE = CD**.

Statement	Reason
In ΔABE and ΔACD	
$AB = AC \rightarrow$ side	given
$\hat{B} = \hat{C} \rightarrow$ angle	$\angle$'s opp. = sides
$BE = CD \rightarrow$ side	given (proved above)
$\therefore \Delta ABE \equiv \Delta ACD$	S.A.S

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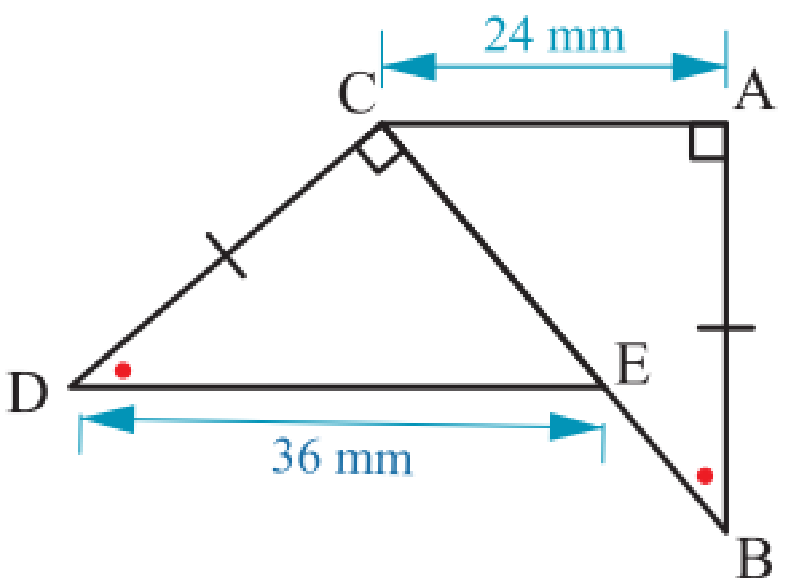
Example 3: **In the diagram below $\hat{B} = \hat{D}$ and $\hat{A} = \hat{C} = 90°$. If AB = CD, AC = 24mm and DE = 36mm:**

a) Prove that $\triangle ABC \equiv \triangle CDE$.
b) Hence, determine the length of CE.
c) What is the length of EB?



	Statement	Reason
a)	In $\triangle ABC$ and $\triangle CDE$	
	$\hat{A} = \hat{C} \rightarrow$ angle	given
	$\hat{B} = \hat{D} \rightarrow$ angle	given
	AB = CD $\rightarrow$ side	given
	$\therefore \triangle ABC \equiv \triangle CDE$	A.A.S
b)	AC = CE = 24mm	congruent $\triangle$'s
c)	CB = DE = 36mm	congruent $\triangle$'s
	CB = CE + EB	
	$\therefore 36 = 24 + EB$	
	$\therefore 36 - 24 = EB$	
	$\therefore 12 = EB$	
	$\therefore EB = 12mm$	

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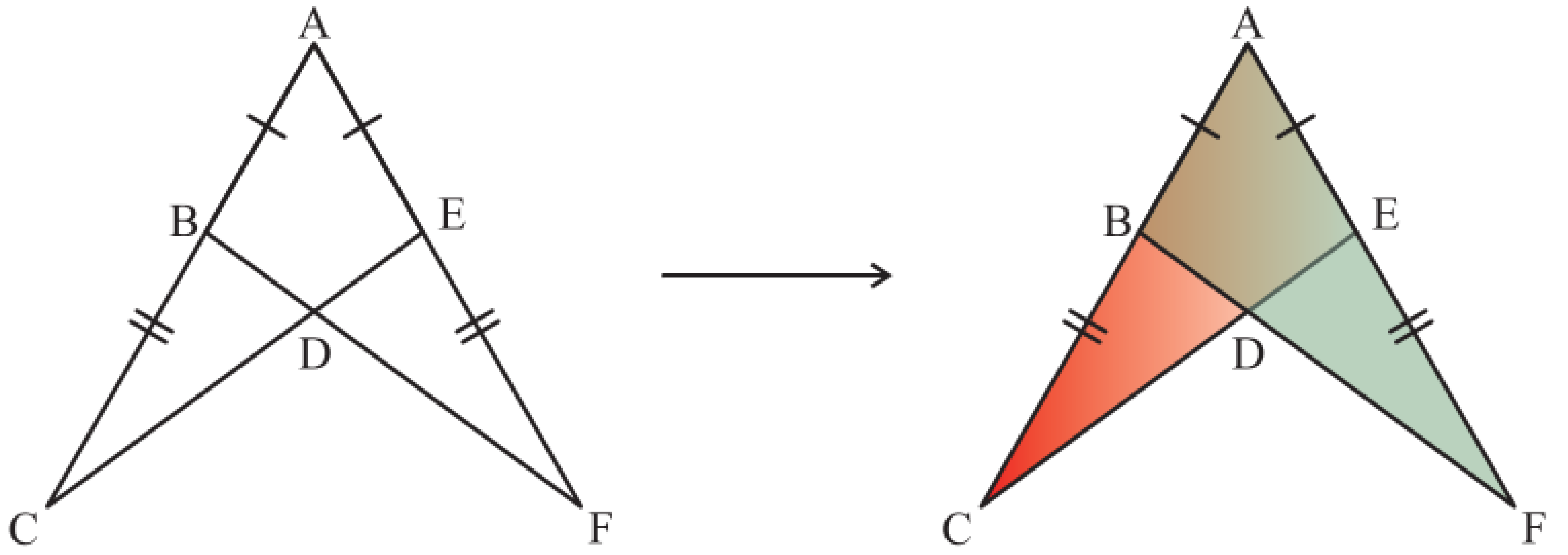
Example 4: **In the diagram below AB = AE and BC = EF.**
Prove that ∆ACE ≡ ∆AFB.



Before starting this problem, note that **AC = AB + BC** and **AF = AE +EF**. It is also given that **AB = AE** and **BC = EF**.
∴ AC = AF

Statement	Reason
In ∆ACE and ∆AFB	
AE = AB → side	given
$\hat{A} = \hat{A}$ → angle	common ∠
AC = AF → side	given (proved above)
∴ ∆ACE ≡ ∆AFB	S.A.S

Complete Exercise 4 numbers 2 - 4 on pages 325 and 326 and the Mixed Exercise on pages 326 and 327.

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2024

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...

A. eliminate unfair discrimination and promote equal opportunities for all.

B. improve employment opportunities of disadvantaged people.

C. transform South African companies by encouraging black management.

D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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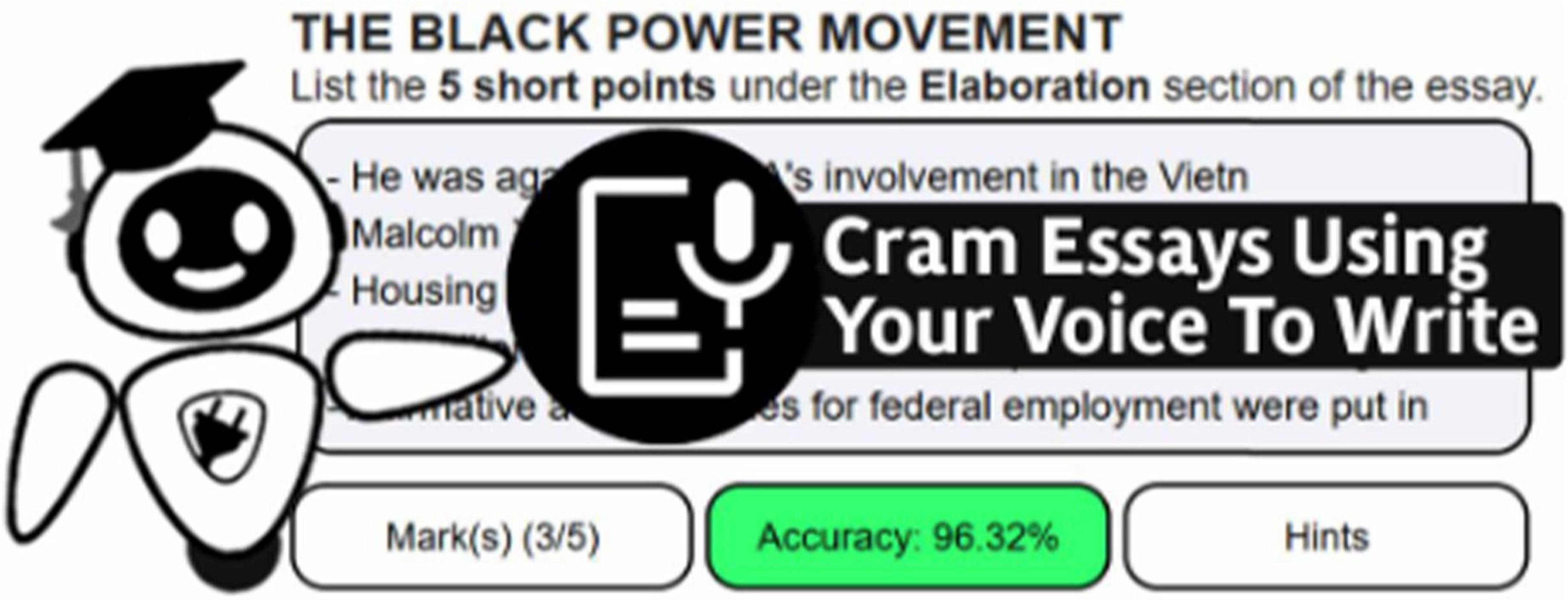

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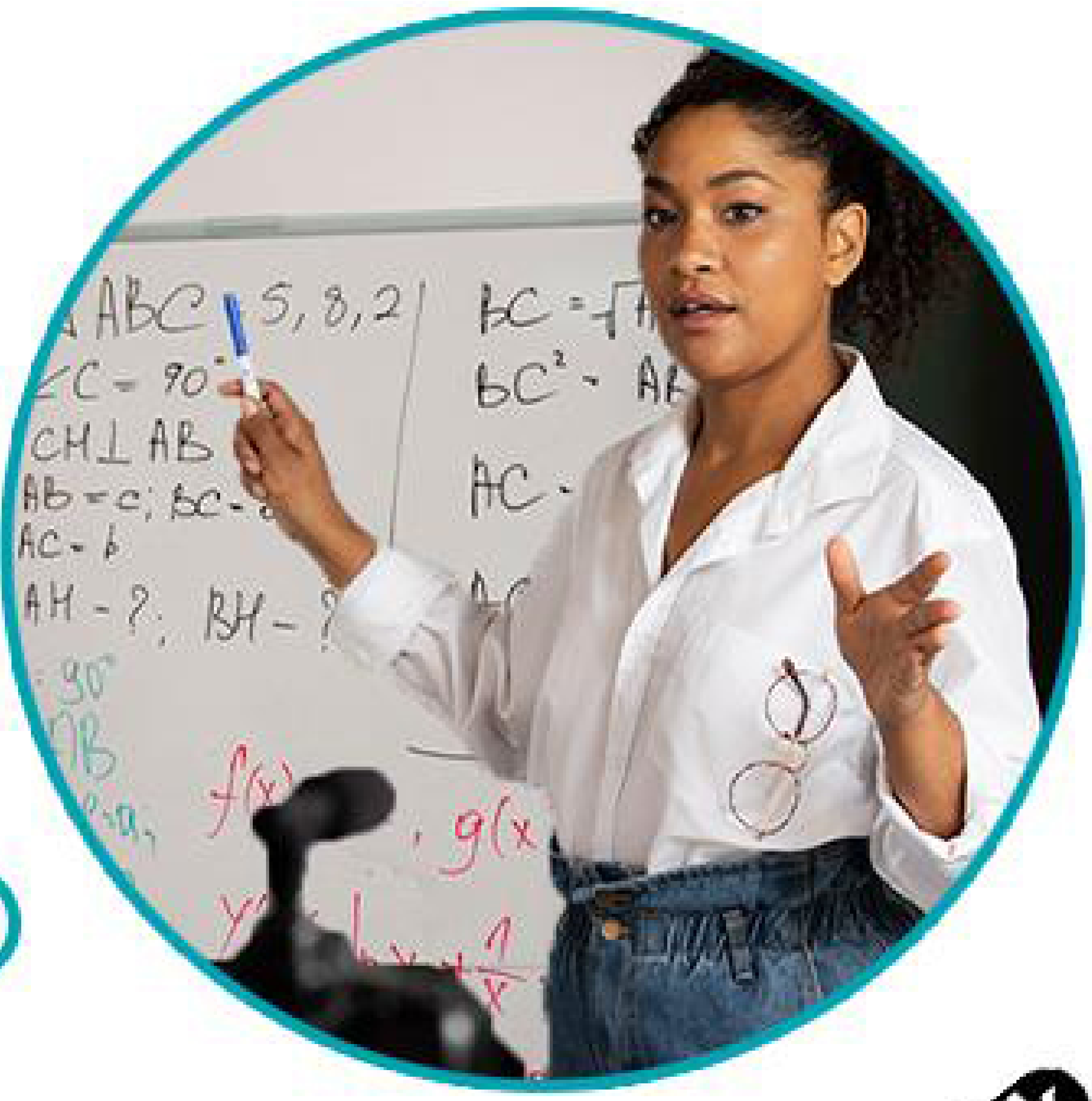

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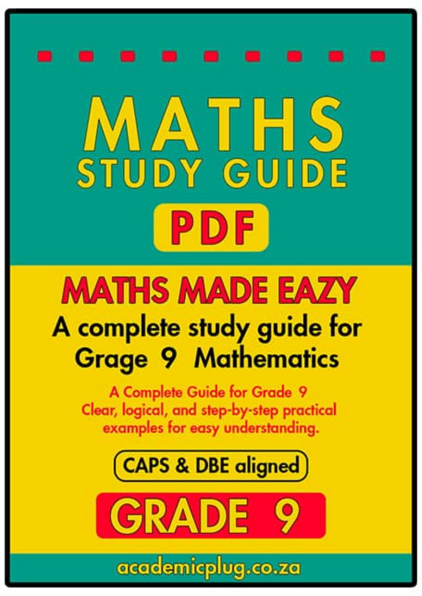

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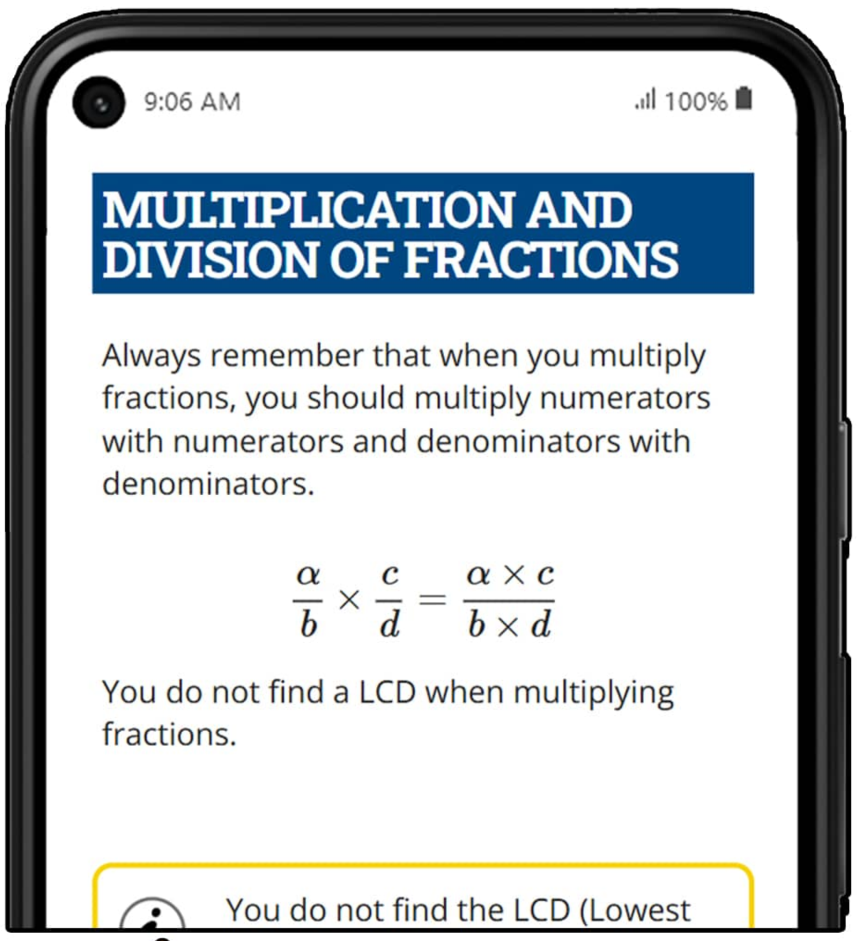

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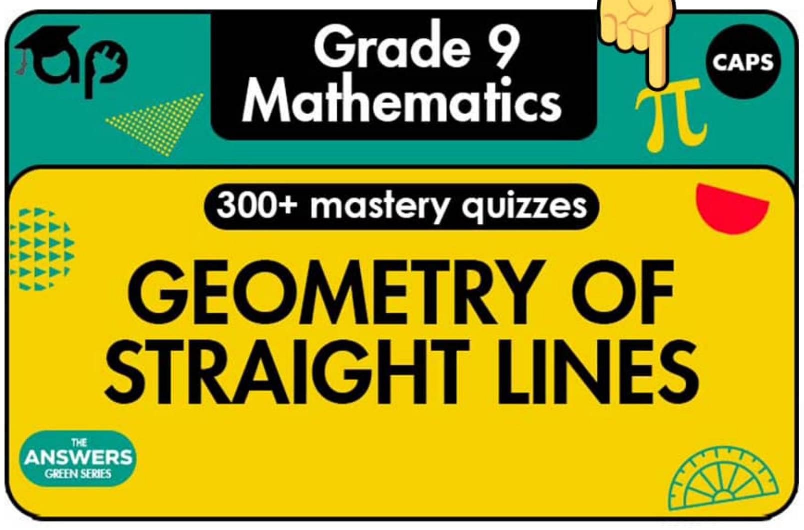

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CHAPTER 13 – GEOMETRY OF STRAIGHT LINES

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
141 142	**A. Properties of Lines** • Parallel Lines	3.3	• Write clear descriptions of the relationship between angles formed by perpendicular lines, intersecting lines and parallel lines • Solve geometric problems using the relationships between pairs of angles described above

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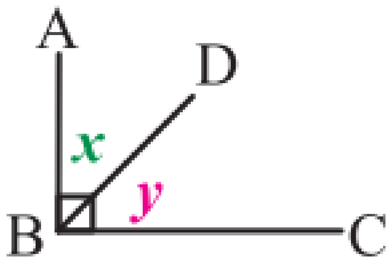
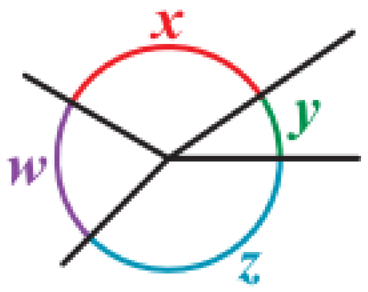
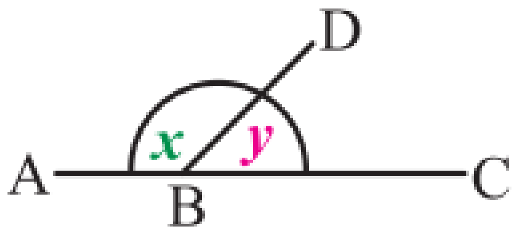
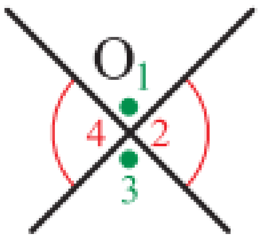
A. PROPERTIES OF LINES

The properties of lines were revised in Chapter 12. You have already worked with these properties in the previous chapter and in Grade 8. You will now extend these principles to deal with questions at Grade 9 levels. The properties of lines are summarised again below.

Property	Illustration	Reason
Complementary angles add up to 90°.	 In the above diagram: $x + y = 90°$	**comp. ∠'s**
The angles around a point add up to 360°.	 In the above diagram: $x + y + z + w = 360°$	**∠'s around a pt.**
Adjacent angles on a straight line are supplementary. **Supplementary means adds up to 180°.**	 In the above diagram: $x + y = 180°$	**adj. ∠'s on a str. line**
Vertically Opposite angles are equal	 In the above diagram: $\hat{O}_1 = \hat{O}_3$ **and** $\hat{O}_2 = \hat{O}_4$	**vert. opp. ∠'s**

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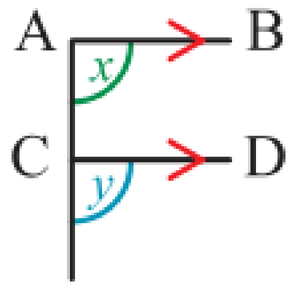
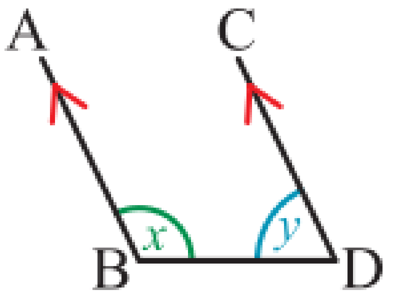
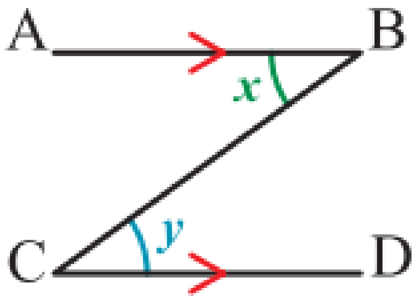
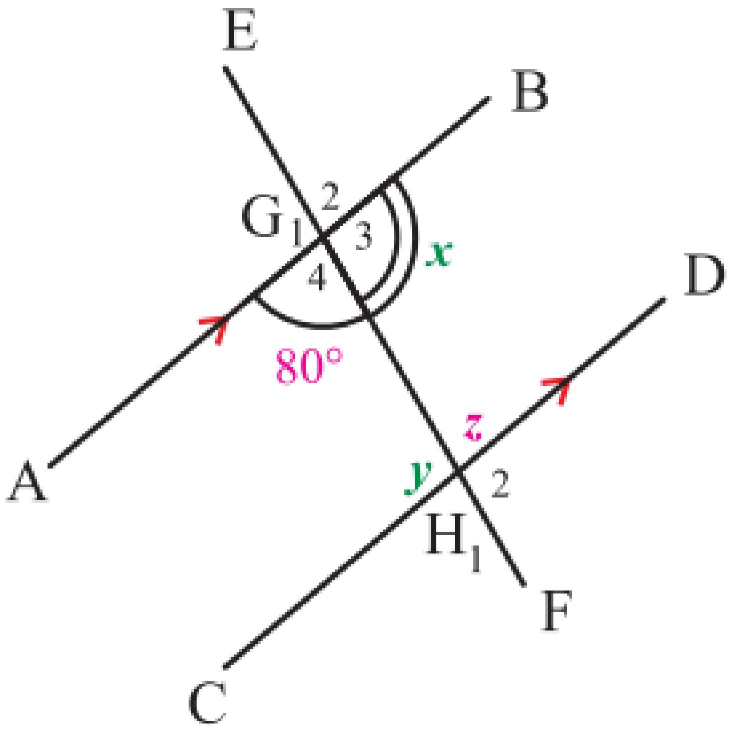
PARALLEL LINES

Property	Illustration	Reason
Corresponding Angles (F - Shape)	 $x = y$	**corr. ∠'s (AB // CD)**
Co-interior (U – Shape)	 $x + y = 180°$	**co-int. ∠'s (AB // CD)**
Alternate Angles (Z – Shape) / (N – Shape)	 $x = y$	**alt ∠'s (AB // CD)**

When using the properties of parallel lines, you must state the parallel lines you are using in your reason. The symbol for parallel is //.

<u>Example 1</u>: Determine the value of x, y and z in the diagram below:



Statement	Reason
$z = G_4 = 80°$	alt. ∠'s (AB//CD)
$x = 180° - G_4$ $= 180° - 80°$ $= 100°$	adj. ∠'s on a str. Line
$y = x = 100°$	alt. ∠'s (AB//CD)

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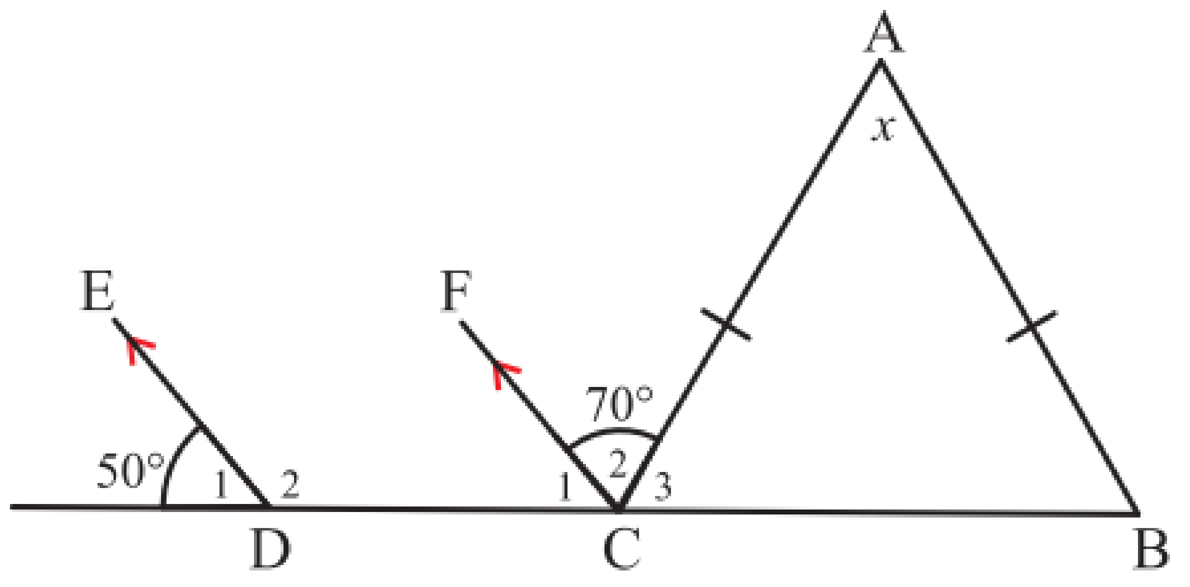
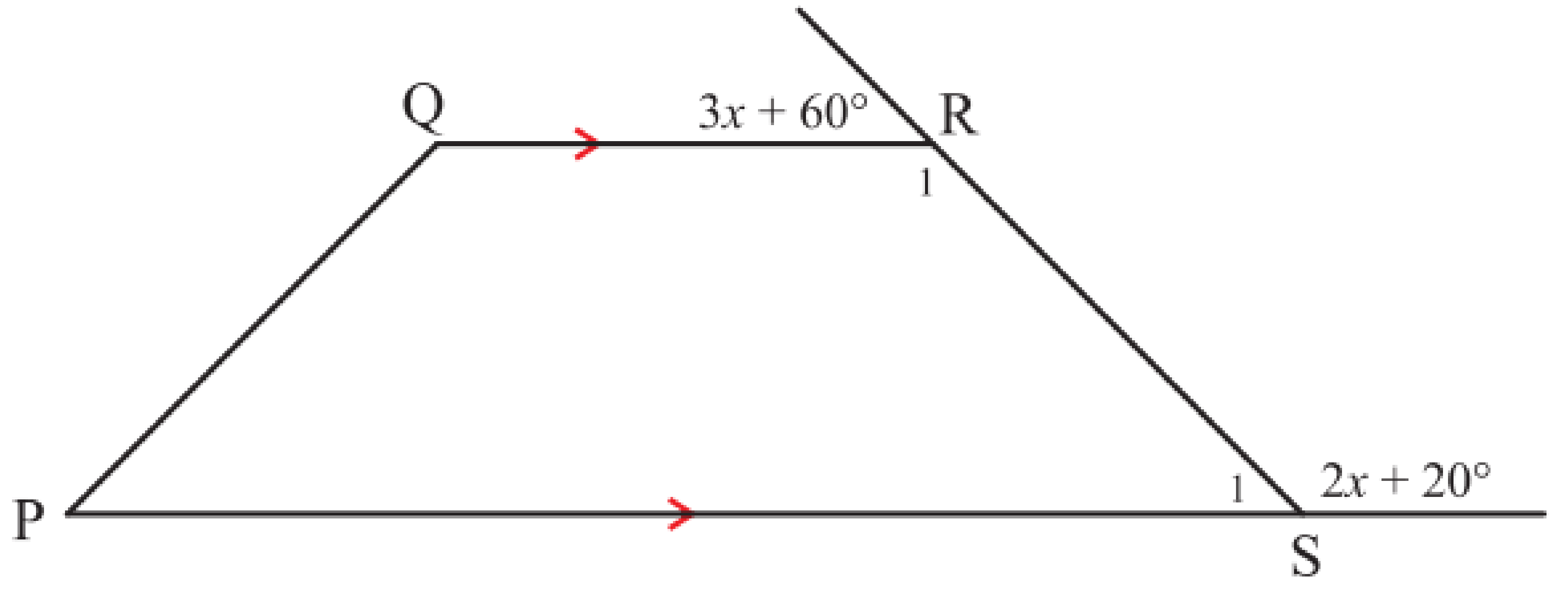
<u>Example 2</u>: Determine the value of x in figure below:



Statement	Reason
$\hat{C}_1 = 50^\circ$	corr. ∠'s (ED//FC)
$\hat{C}_3 = 180^\circ - 70^\circ - 50^\circ$	adj. ∠'s on a str. line
$= 60^\circ$	
$\therefore \hat{A} = \hat{B} = \hat{C}_3 = x = 60^\circ$	ABC is an equilateral △

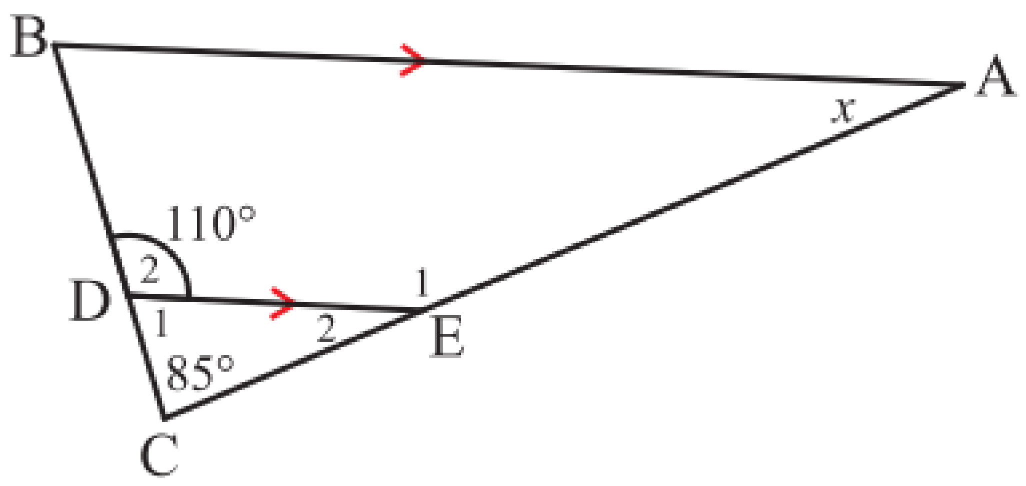
If one of the angles in an isosceles triangle is 60°, the triangle has to be an equilateral triangle.

<u>Example 3</u>: Determine the value of x in the figure below given that QR//PS.



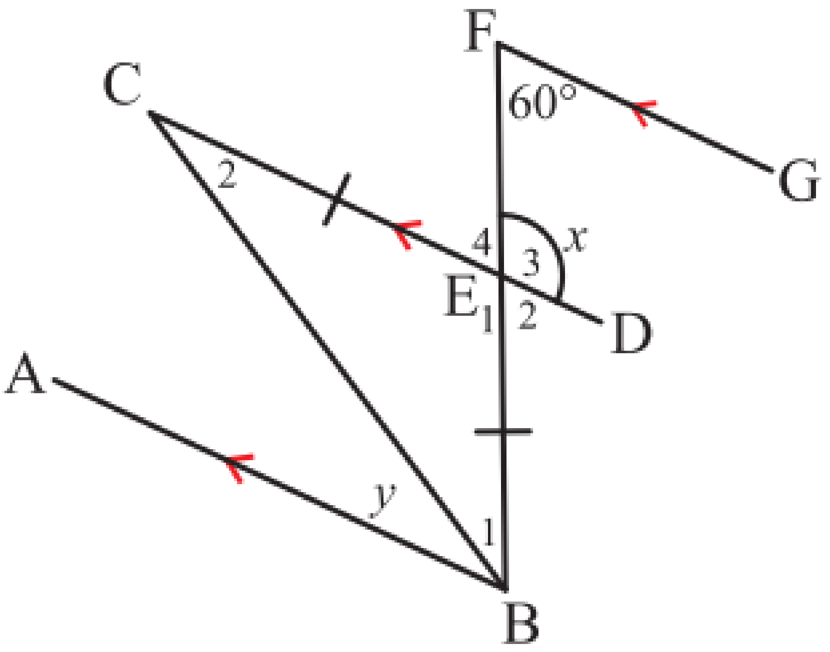
Statement	Reason
$\hat{R}_1 = 2x + 20^\circ$	alt. ∠'s (QR//PS)
$\hat{R}_1 + 3x + 60^\circ = 180^\circ$	adj. ∠'s on a str. line
$\therefore 2x + 20^\circ + 3x + 60^\circ = 180^\circ$	
$\therefore 5x = 100^\circ$ → divide both sides by 5	
$\therefore x = 20^\circ$	

Example 4: In the diagram below $\hat{A} = x$, $\hat{D}_2 = 110°$ and $\hat{C} = 85°$. Determine the value of x.



Statement	Reason
$\hat{E}_2 + \hat{C} = \hat{D}_2$	ext. ∠ of Δ
$\hat{E}_2 + 85° = 110°$	
$\therefore \hat{E}_2 = 25°$	
$\hat{E}_2 = \hat{A} = x$	corr. (BA//DE)
$\therefore x = 25°$	

Example 5: In the figure below FG//CD//AB and $\hat{F} = 60°$. Determine the value of x and y.



Statement	Reason
$x = 180° - 60°$	co-int. ∠'s (EB//DC)
$\quad = 120°$	
$\hat{E}_1 = \hat{E}_3 = 120°$	vert. opp. ∠'s
$\hat{C}_2 = \hat{B}_1$	∠'s opp. = sides
$\hat{C}_2 + \hat{B}_1 + \hat{E}_1 = 180° \rightarrow \hat{B}_1 = \hat{C}_2$	∠'s in a Δ
$\therefore \hat{C}_2 + \hat{C}_2 + 120° = 180°$	
$\therefore 2\hat{C}_2 = 60°$	
$\therefore \hat{C}_2 = 30°$	
$y = \hat{C}_2 = 30°$	alt. ∠'s (CD//AB)

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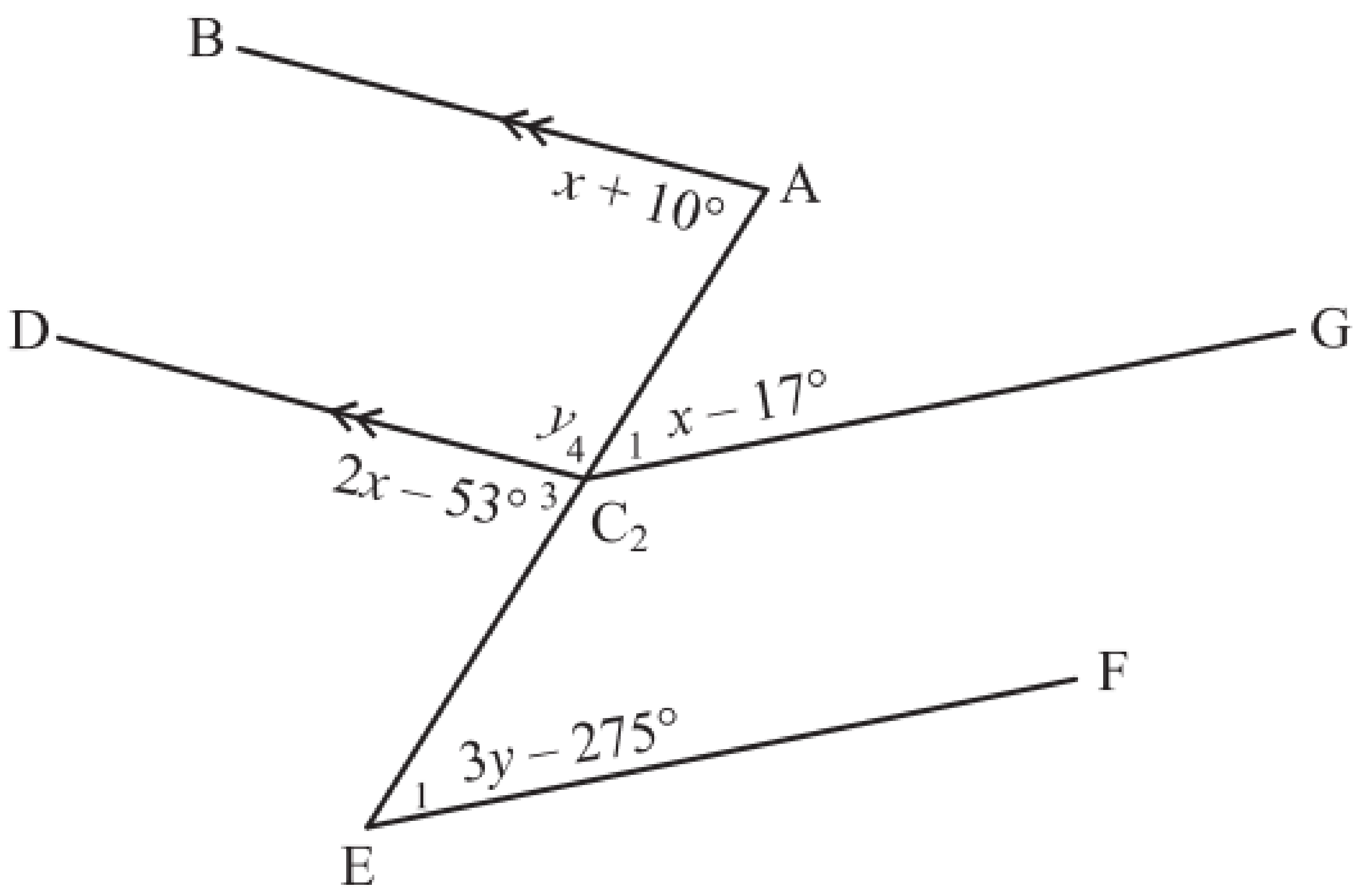
Example 6: In the figure below AB//CD. Determine the value of x and y.

a) Determine the value of x and y.

b) Prove that CG is not parallel to AB.

c) Is CG parallel to EF? Give reason for your answer.



a)

Statement	Reason
$2x - 53^\circ = x + 10^\circ$	corr. ∠'s (AB//CD)
$\therefore x = 10^\circ + 53^\circ$	
$\therefore x = 63^\circ$	
$y + 2x - 53^\circ = 180^\circ \rightarrow x = 63^\circ$	adj. ∠'s on str. line
$y = 180^\circ + 53^\circ - 2(63^\circ)$	
$= 107^\circ$	

b)

Statement	Reason
$\hat{A} = 63^\circ + 10^\circ \rightarrow x = 63^\circ$	
$= 73^\circ$	
$\hat{C}_1 = 63^\circ - 17^\circ \rightarrow x = 63^\circ$	
$= 46^\circ$	
$\therefore \hat{A} \neq \hat{C}_1$	
$\therefore$ AB is not parallel to CG	alt. ∠'s are not equal

c)

Statement	Reason
$\hat{C}_1 = 46^\circ$	
$\hat{E}_1 = 3(107^\circ) - 275^\circ \rightarrow y = 107^\circ$	
$= 46^\circ$	
$\therefore \hat{C}_1 = \hat{E}_1$	
$\therefore$ CG//EF	corr. ∠'s are =

Complete the Mixed Exercise on pages 335 and 336.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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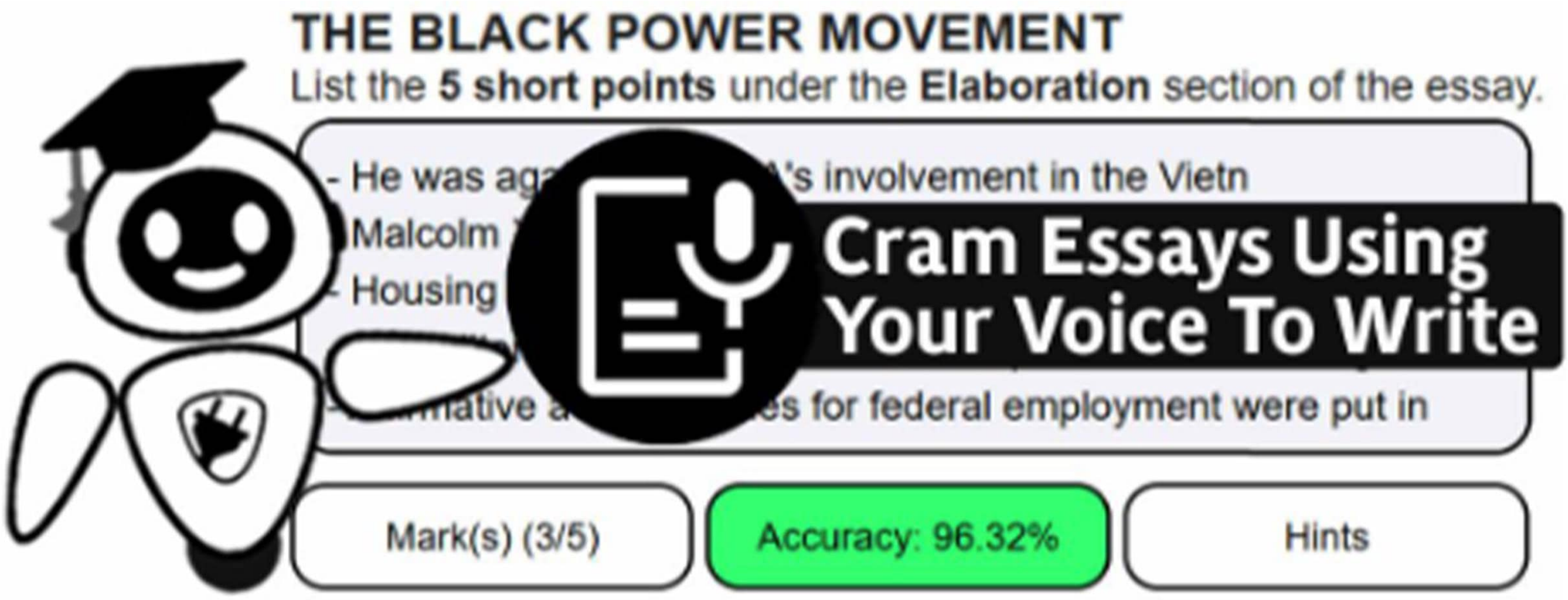

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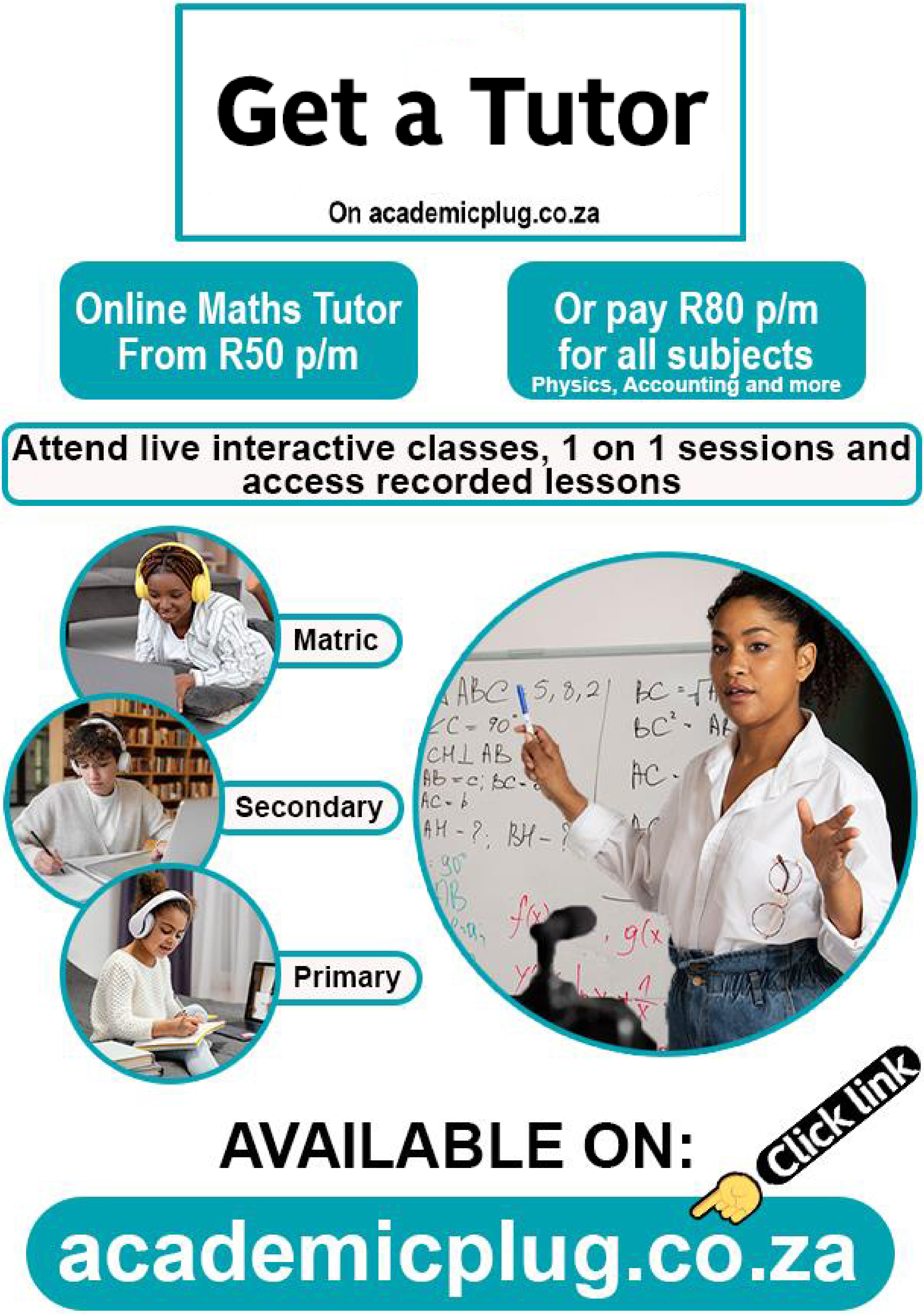
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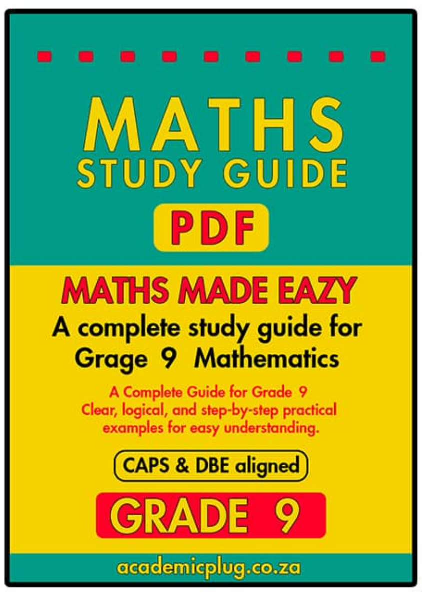

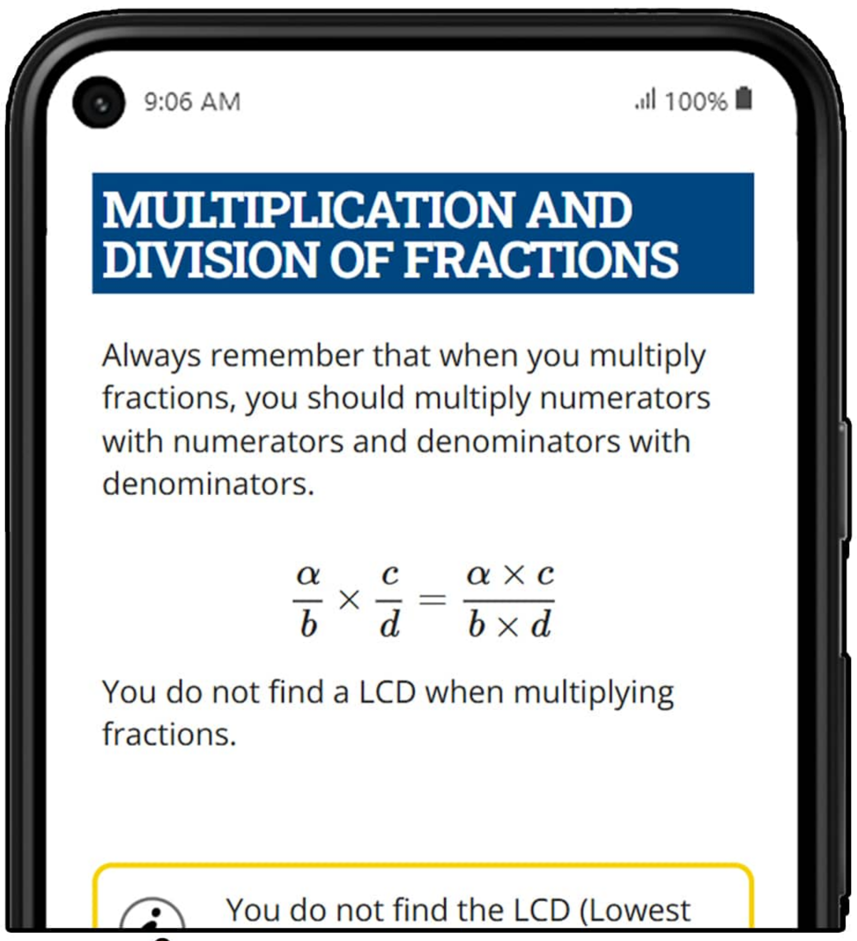

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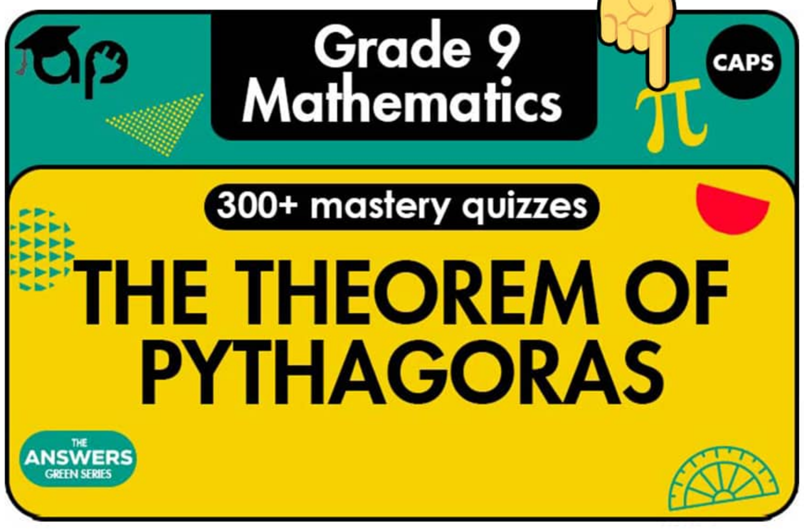

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CHAPTER 14
THE THEOREM OF PYTHAGORAS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
147	**A. Pythagoras Revision**	4.3	• Use the Theorem of Pythagoras to solve problems involving unknown lengths in geometric figures that contain right-angled triangles
147	• The Theorem of Pythagoras		
148	• Determining if a Triangle is Right-Angled		
148	• Mixed Examples		

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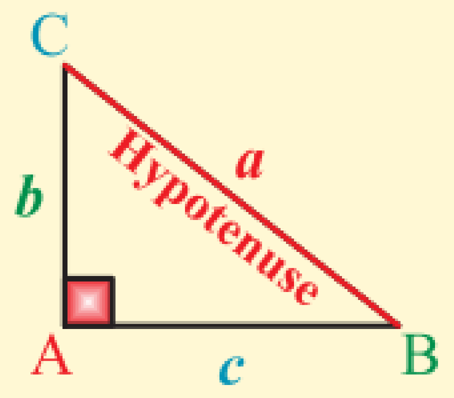
A. PYTHAGORAS REVISION

You have already encountered the theorem of Pythagoras in Grade 8 and the previous chapter. We will now extend this concept into Grade 9.

THE THEOREM OF PYTHAGORAS

The Theorem of Pythagoras states that **the square of the hypotenuse is equal to the sum of the squares of the other two sides**.



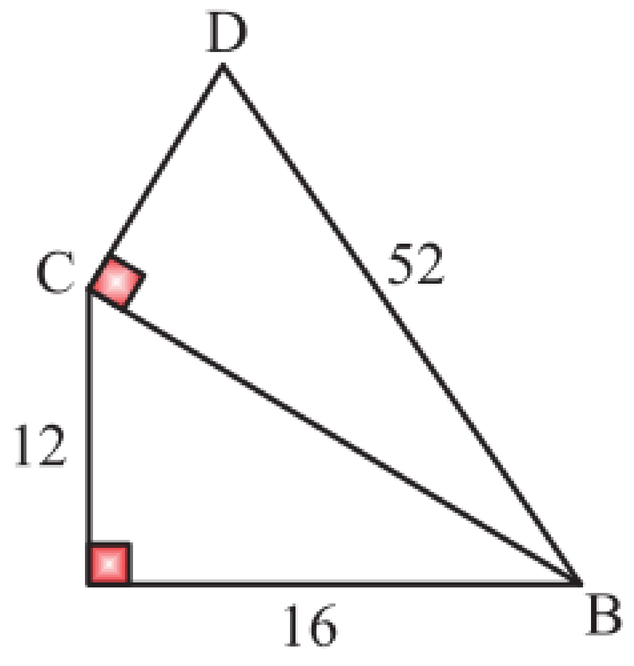
The Theorem of Pythagoras

$$a^2 = b^2 + c^2$$

$$b^2 = a^2 - c^2$$

$$c^2 = a^2 - b^2$$

Example 1: Determine the length of BC and CD in the diagram below.



$BC^2 = AC^2 + AB^2 \rightarrow$ pythag

$\therefore BC^2 = 12^2 + 16^2$

$\therefore BC^2 = 144 + 256$

$\therefore BC^2 = 400 \rightarrow$ square root both sides

$\therefore BC = 20$ units $\rightarrow$ if no units are given write units

$CD^2 = BD^2 - BC^2 \rightarrow$ pythag

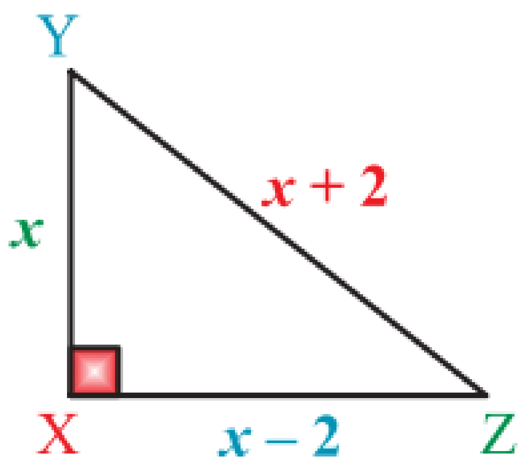
$\therefore CD^2 = 52^2 - 20^2$

$\therefore CD^2 = 2\,704 - 400$

$\therefore CD^2 = 2\,304$

$\therefore CD = 48$ units $\rightarrow$ if no units are given write units

Example 2: Determine the value of *x* in the diagram below:



$(x+2)^2 = x^2 + (x-2)^2 \rightarrow$ pythag

$\therefore x^2 + 4x + 4 = x^2 + x^2 - 4x + 4$

$\therefore -x^2 + 8x = 0 \rightarrow$ multiply both sides by -1

$\therefore x^2 - 8x = 0 \rightarrow$ take out a HCF of x

$\therefore x(x-8) = 0$

$\therefore x \neq 0 \quad$ or $\quad x = 8 \rightarrow$ a length cannot equal 0

$\therefore x = 8$ units $\rightarrow$ if no units are given write units

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DETERMINING IF A TRIANGLE IS RIGHT-ANGLED

1. **Square the longest side (this is the hypotenuse if the triangle is right-angled).**
2. **Square the other two sides and add them together.**
3. **If your answer in step 1 is equal to your answer in step 2, the Theorem of Pythagoras applies and the triangle is right angled.**

The right angle is always opposite the longest side.

Example 1: In triangle ABC, AB = 38cm, BC = 360cm, AC = 362cm. Is triangle ABC a right-angled triangle?

$AC^2 = 362^2 \rightarrow$ longest side squared

$= 131\,044$

$AB^2 + BC^2 = 38^2 + 360^2$

$= 1444 + 129\,600$

$= 131\,044$

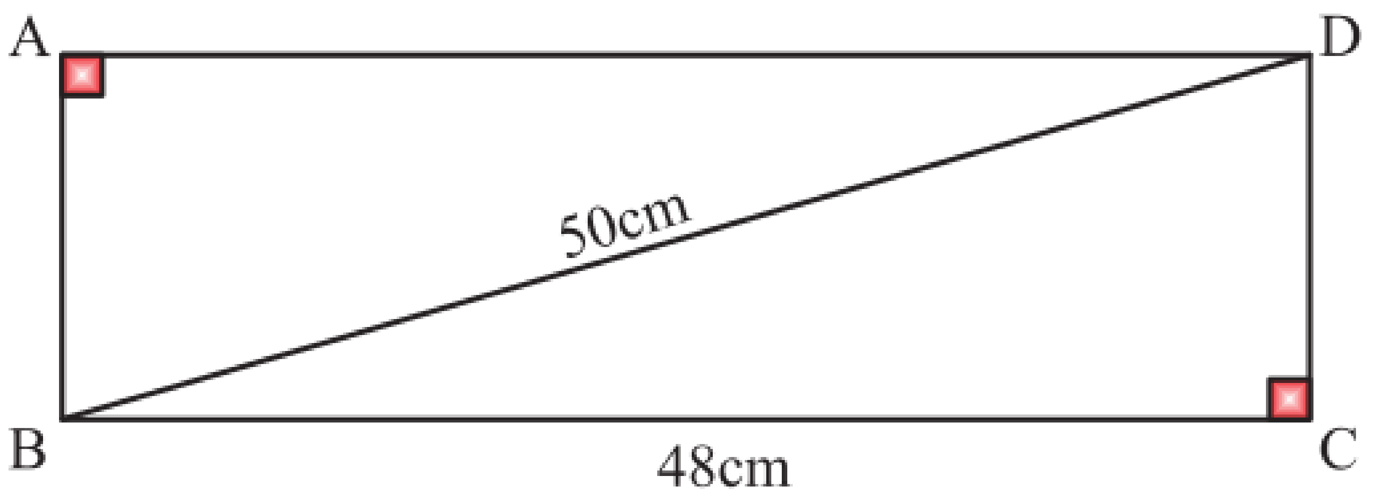
$\therefore AC^2 = AB^2 + BC^2$

$\therefore$ The triangle is right-angled at $\hat{B}$

The letter that is missing in the hypotenuse is the angle opposite the hypotenuse and the right-angle. In the above example, AC is the hypotenuse, which means the right-angle is at $\hat{B}$.

MIXED EXAMPLES

Example 1: Determine the perimeter of rectangle ABCD below.



$CD^2 = BD^2 - BC^2 \rightarrow$ Pythag

$= 50^2 - 48^2$

$= 196$

$CD = 14\text{ cm} \rightarrow \sqrt{196} = 14$

$\text{Perimeter} = 2(BC) + 2(CD)$

$= 2(48) + 2(14)$

$= 124\text{ cm}$

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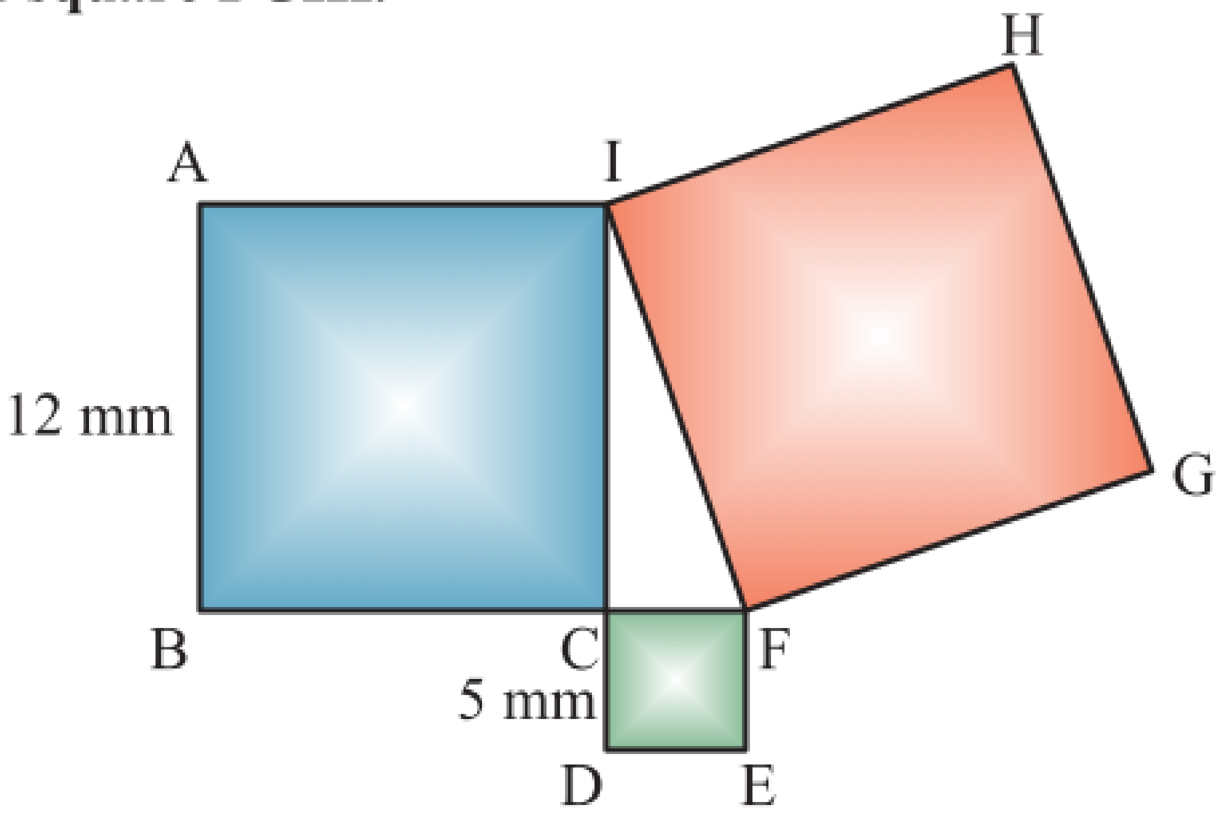
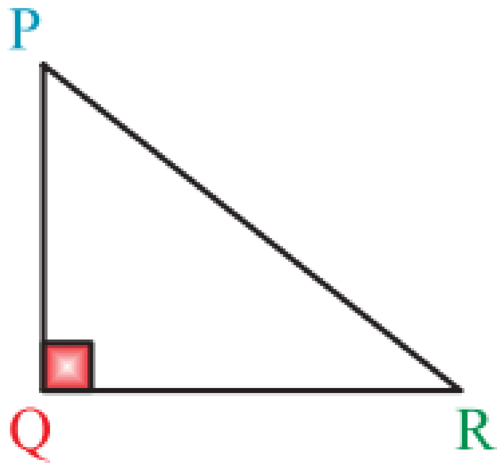
Example 2: **The shapes shown below are squares. Determine the area of the red shaded square FGHI.**



$$IF^2 = IC^2 + CF^2 \rightarrow \text{Pythag}$$
$$= 12^2 + 5^2$$
$$= 169$$
$$\therefore IF = 13\text{ mm} \rightarrow \sqrt{169} = 13$$
$$\therefore A_{FGHI} = 13^2 \rightarrow \text{Area of a square} = \text{side}^2$$
$$= 169\text{ mm}^2$$

Example 3: **In the triangle below,** $PR = x^2 + 1$ **and** $PQ = (x-1)(x+1)$**. Determine the length of QR in terms of** x**.**



$$PR^2 = (x^2+1)^2$$
$$= x^4 + 2x^2 + 1$$
$$PQ^2 = [(x-1)(x+1)]^2$$
$$= (x^2-1)^2$$
$$= x^4 - 2x^2 + 1$$
$$QR^2 = PR^2 - PQ^2 \rightarrow \text{Pythag}$$
$$= x^4 + 2x^2 + 1 - (x^4 - 2x^2 + 1) \rightarrow \text{don't forget to distribute the '}-\text{'}$$
$$= x^4 + 2x^2 + 1 - x^4 + 2x^2 - 1$$
$$= 4x^2$$
$$\therefore QR = \sqrt{4x^2}$$
$$= 2x$$

Complete the Mixed Exercise on pages 339 and 340.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

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Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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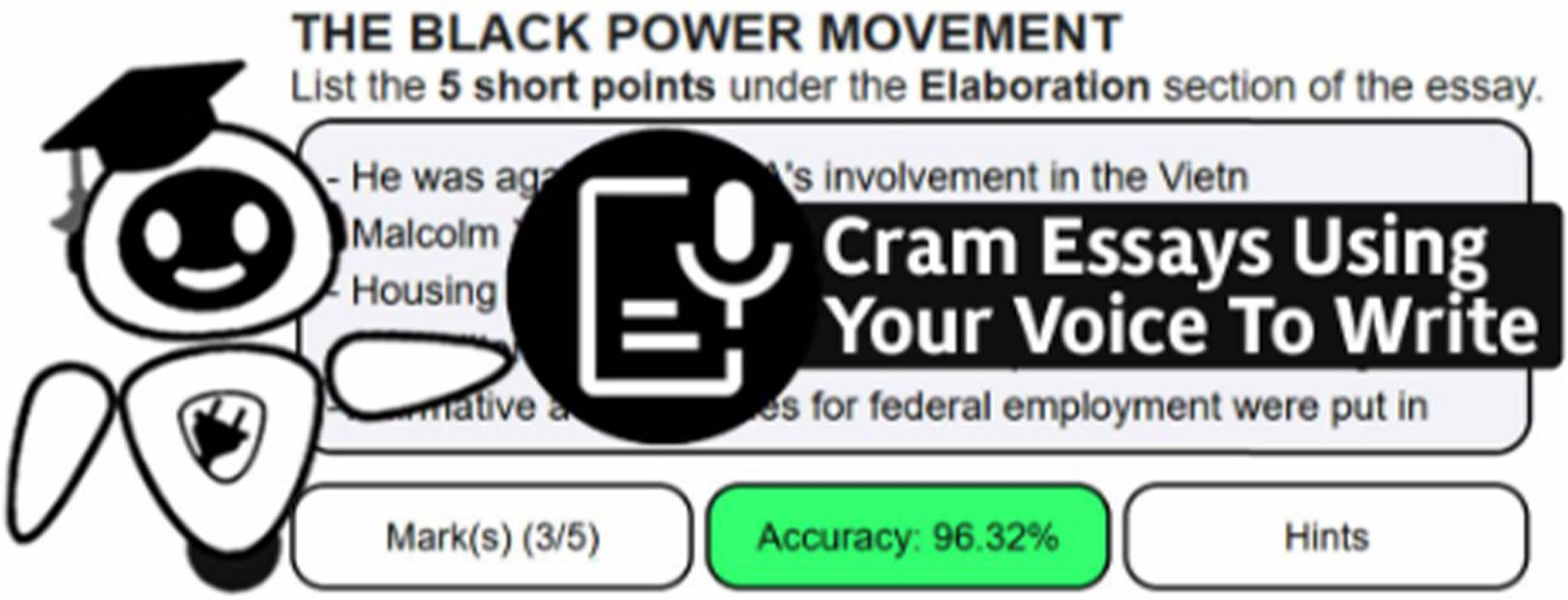

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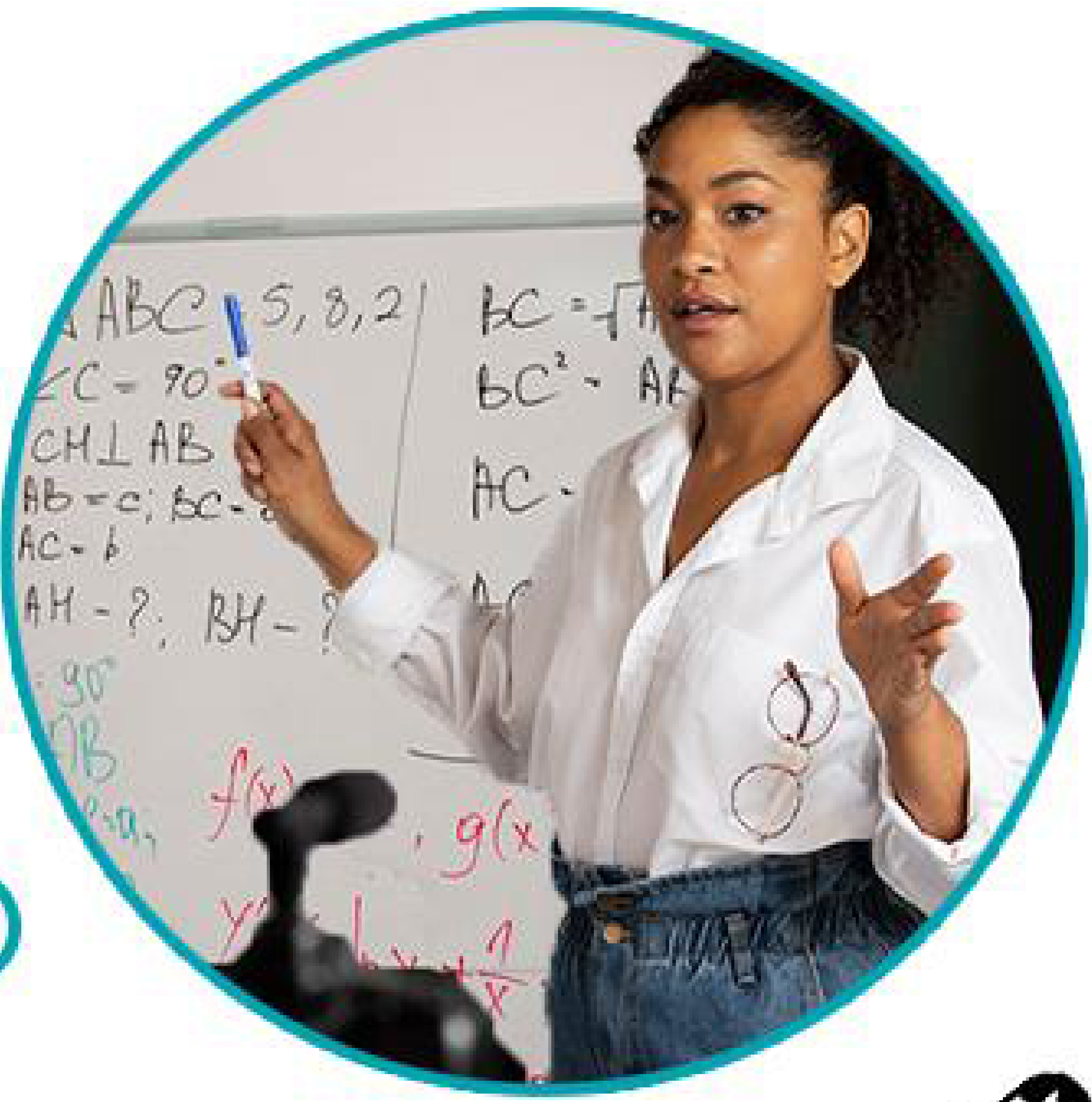

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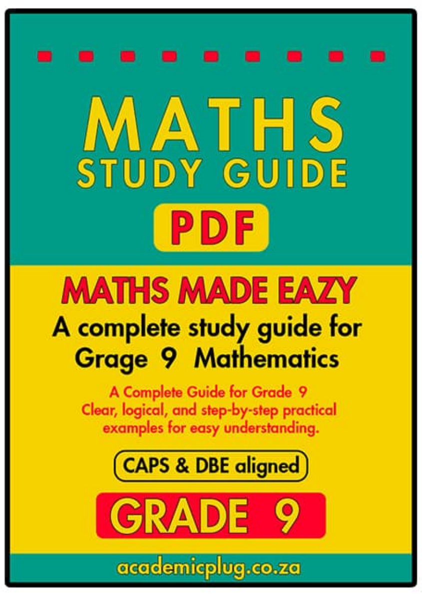

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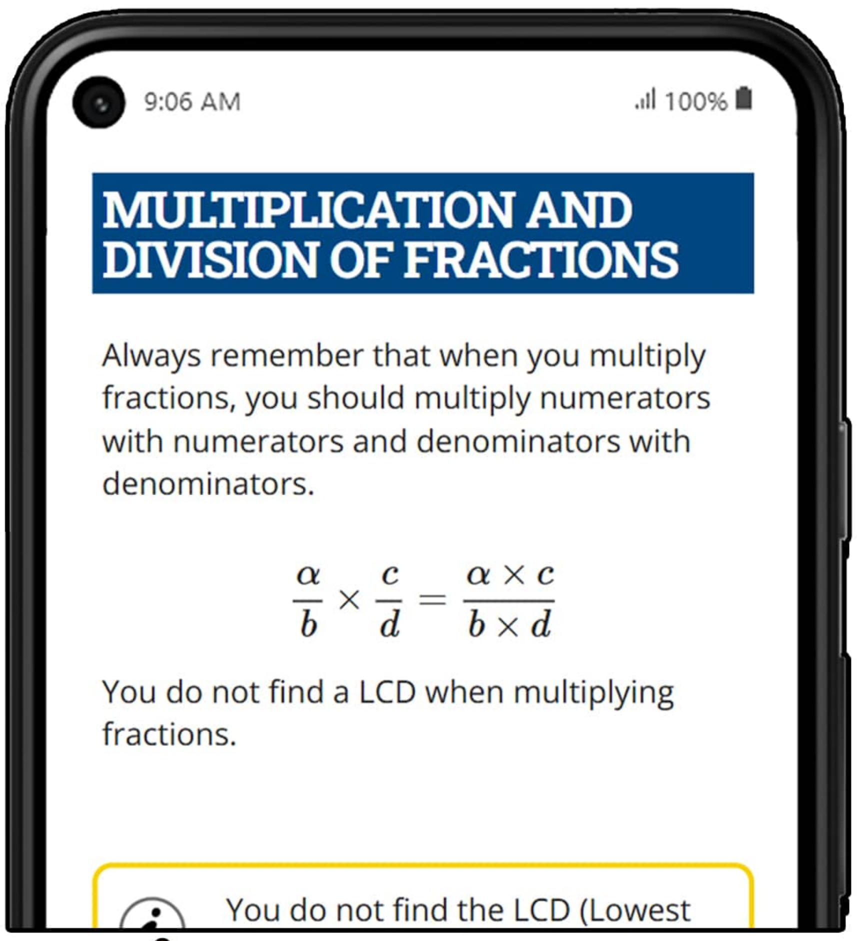

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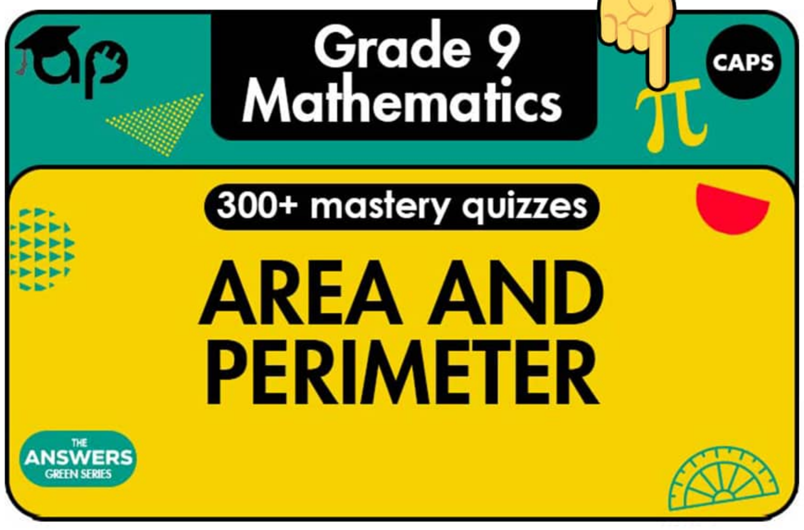

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CHAPTER 15
AREA AND PERIMETER

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
151	**A. Area and Perimeter**	4.1	• Use appropriate formulae and conversions between SI units, to solve problems and calculate the perimeter and area of polygons and circles • State how doubling any or all of the dimensions of a 2D figure affects its perimeter and its area
151	• Converting Between Units		
151	• Heights of Triangles		
152	• Summary of Formulas		
153	• Area of a Trapezium		
153	• Area of a Parallelogram		
153	• Area of a Kite		
158	• Doubling the Dimensions of a 2D - Shape		

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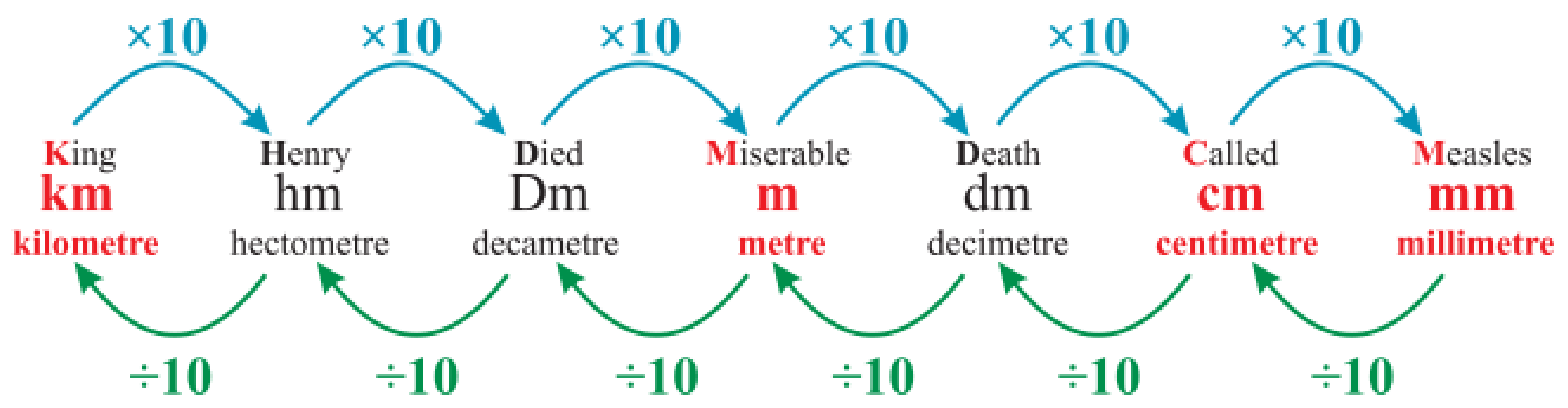
A. AREA AND PERIMETER

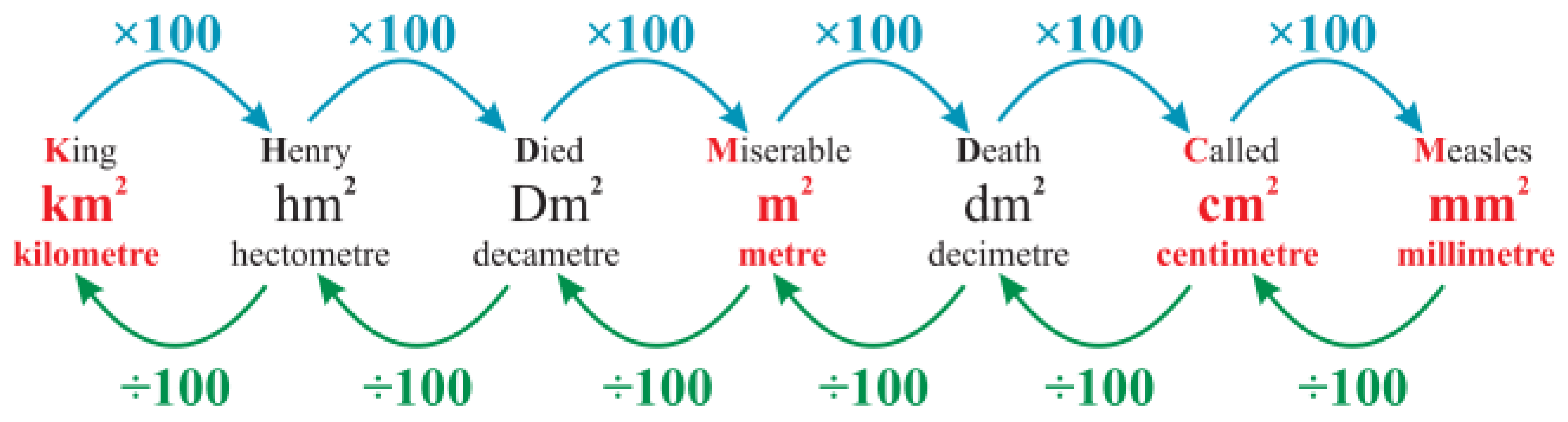
You have already encountered Perimeter in Grade 8.
We will now extend this concept into Grade 9.

CONVERTING BETWEEN UNITS

When calculating **perimeter, all sides** of the shape must be measured in the **same units**. You are required to be able to convert between **kilometres** (**km**), **metres** (**m**), **millimetres** (**mm**) and **centimetres** (**cm**).
The acronym **K**ing **H**enry **D**ied a **M**iserable **D**eath **C**alled **M**easles can be used to convert between the above units. In the diagram below, when **moving** to the **right** you **multiply by 10** and when **moving left** you **divide by 10**.

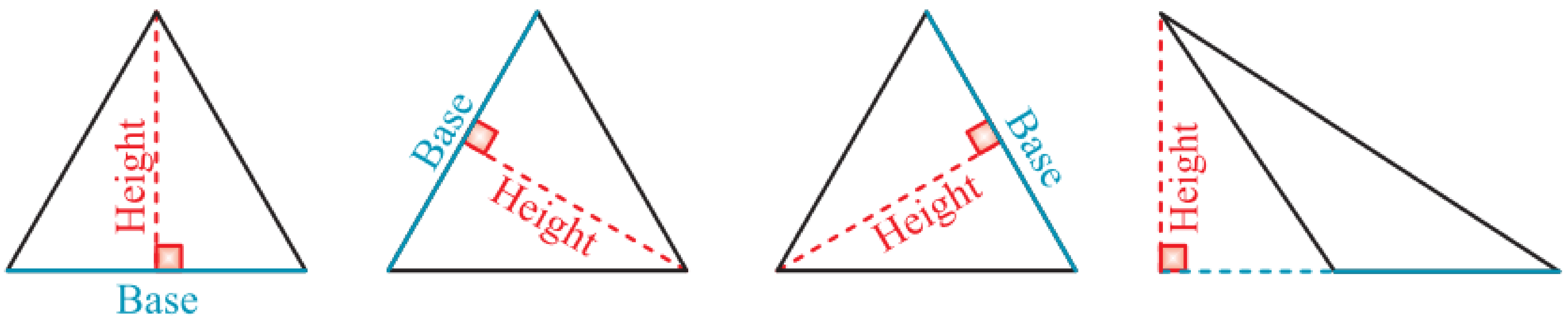


When calculating **area, all sides** of the shape must be measured in the **same units**. You are required to be able to convert between **kilometres²** (**km²**), **metres²** (**m²**), **centimetres²** (**cm²**) and **millimetres²** (**mm²**).
The same acronym and diagram can be used to convert between the above areas. The only difference is when moving **right** on the diagram you **multiply by 100** instead of 10 and when moving **left** you **divide by 100** instead of 10.



HEIGHTS OF TRIANGLES

The **height** of a triangle is **a line drawn from any vertex, perpendicular to the opposite side (base).** The **height** is also **known as an altitude**.
The heights and bases of triangles are shown below.



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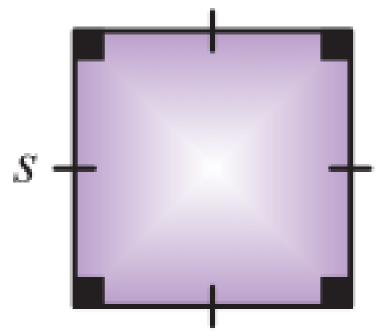
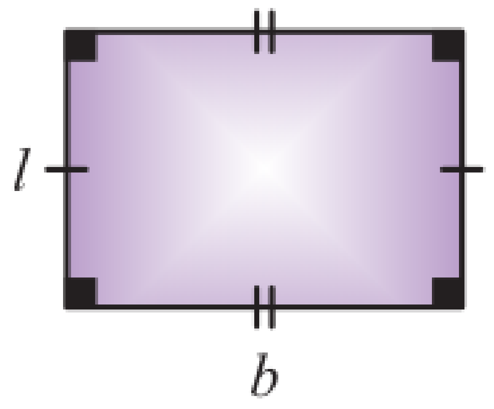
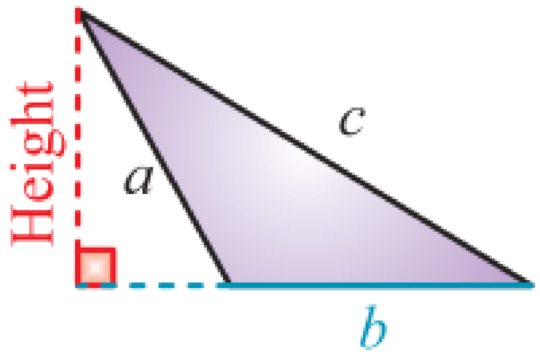
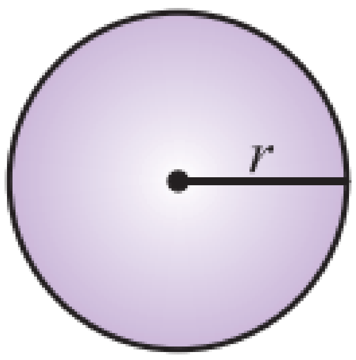
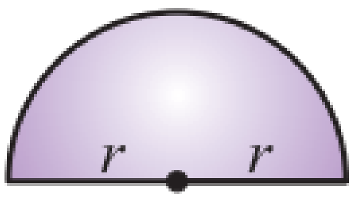
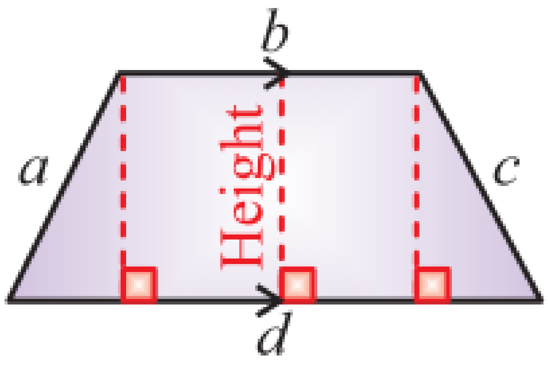
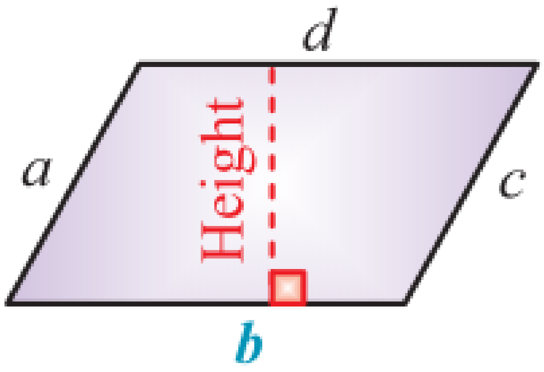
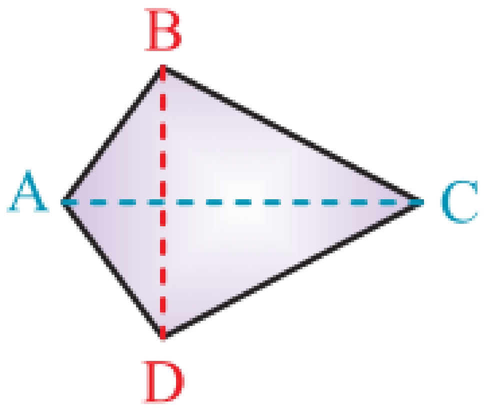
SUMMARY OF FORMULAS

SHAPE	SHAPE	PERIMETRE (P)	AREA (A)
Square (four equal sides)		$P = s + s + s + s$ $= 4s$	$A = s \times s$ $= s^2$
Rectangle (two pairs of opposite sides equal)		$P = l + b + l + b$ $= 2l + 2b$	$A = l \times b$ $= lb$
Triangle		$P = a + b + c$	$A = \frac{1}{2} \text{base} \times H$
Circle		$C = 2\pi r$ or $C = \pi d$	$A = \pi r^2$
Semi - Circle		$P = \pi r + d$	$A = \frac{\pi r^2}{2}$
Trapezium		$P = a + b + c + d$	$A = \frac{1}{2}(b + d) \times H$
Parallelogram		$P = a + b + c + d$	$A = b \times H$
Kite		$P = AB + BC + CD + AD$	$A = \frac{AC \times BD}{2}$

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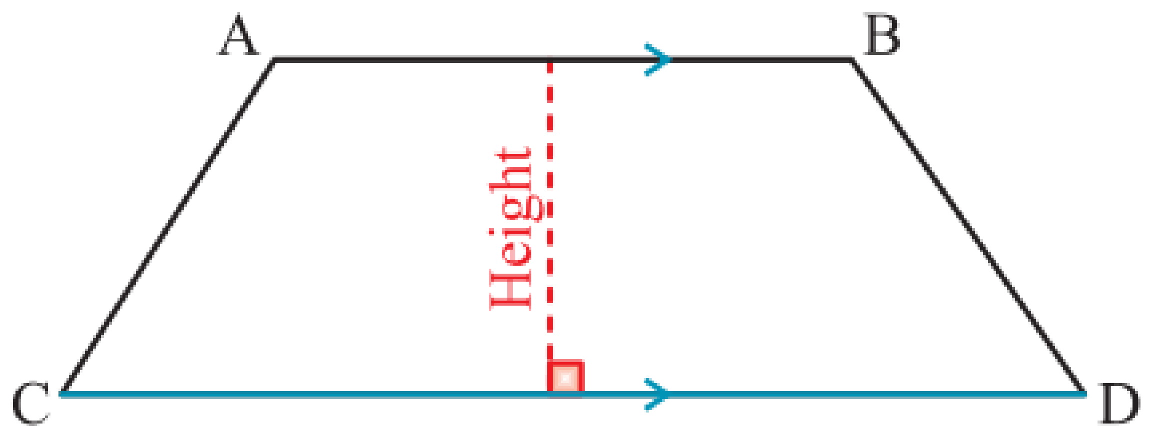
AREA OF A TRAPEZIUM

The **area of a trapezium** is equal to **half the sum of the parallel sides multiplied by the perpendicular height**.

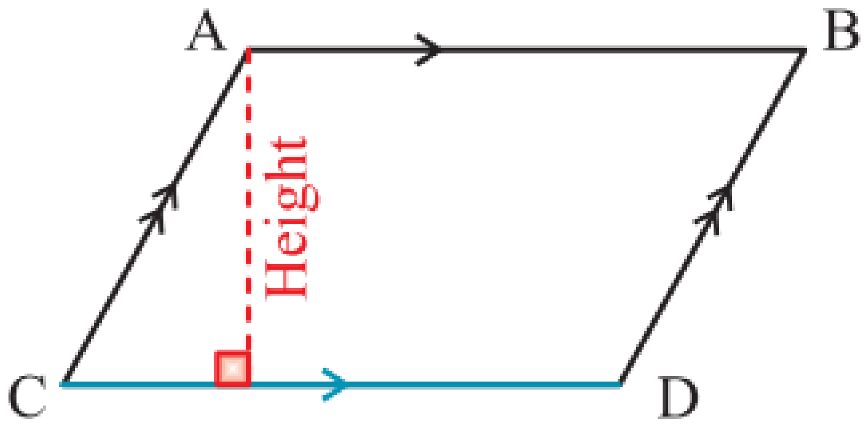


Formula:

$$\text{Area} = \frac{1}{2}(AB \times CD) \times \perp \text{Height}$$

AREA OF A PARALLELOGRAM

The **area of a parallelogram** is equal to **product of the base and perpendicular height**.

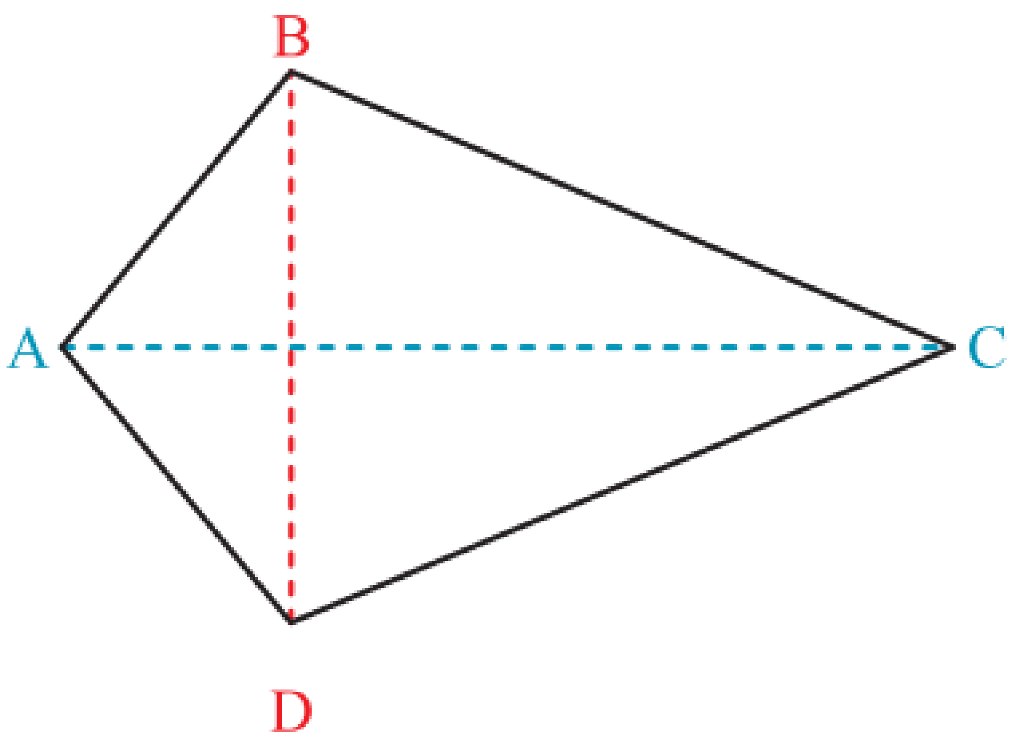


Formula:

$$\text{Area} = CD \times \perp \text{Height}$$

AREA OF A KITE

The **area of a kite** is equal to **product of the diagonals divided by 2.**



Formula:

$$\text{Area} = \frac{AC \times BD}{2}$$

Complete the Exercise 1 on pages 343 and 344.

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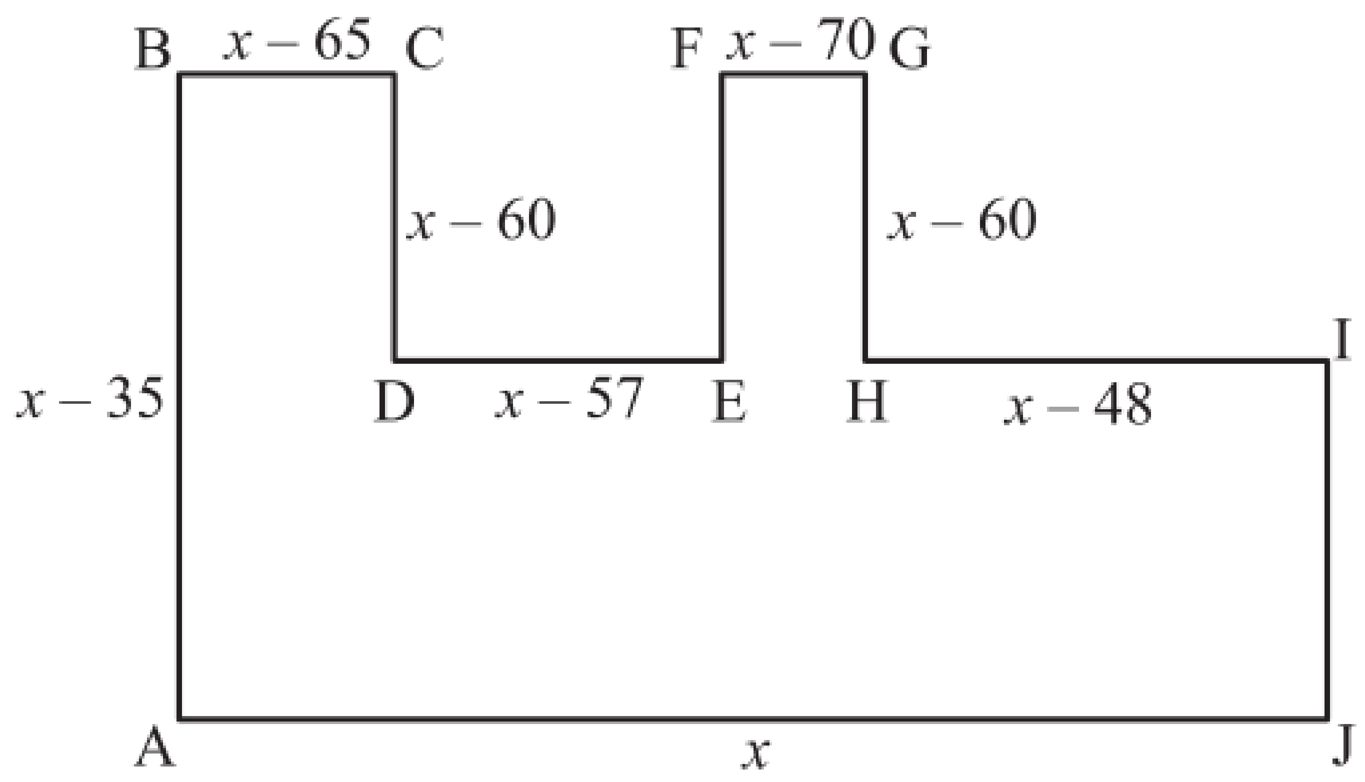
Example 1: **In the figure below all dimensions are in centimetres. Determine:**

a) The length of IJ.

b) The value of x if the perimeter of the figure is 290cm.

c) The area of the figure.



a) $IJ = AB - DC$

$= x - 35 - (x - 60) \rightarrow$ don't forget to distribute the '$-$'

$= x - 35 - x + 60$

$= 25\,\text{cm}$

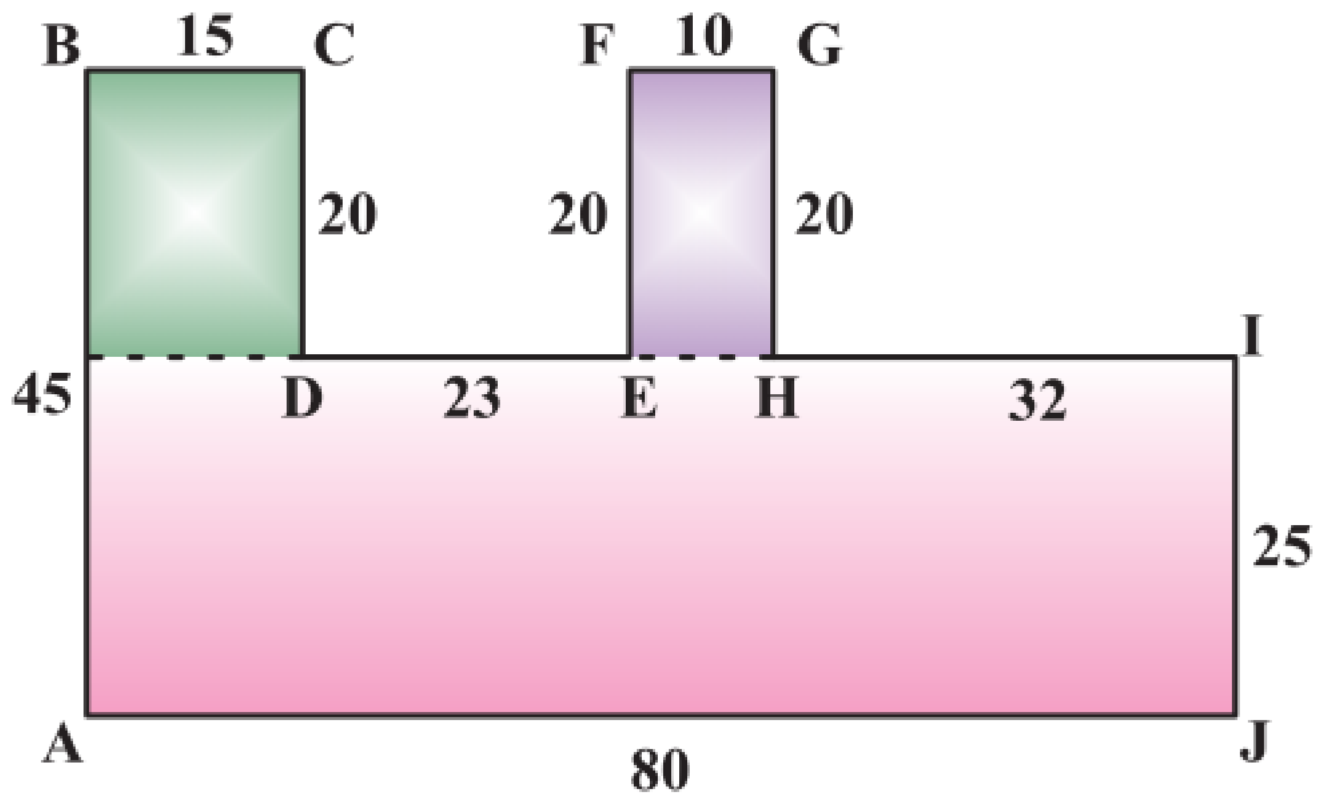
b) $P = x + x - 35 + x - 65 + x - 60 + x - 57 + x - 60 + x - 70 + x - 60 + x - 48 + 25$

$\therefore 290 = 9x - 430$

$\therefore -9x = -720 \rightarrow$ divide both sides by -9

$\therefore x = 80\,\text{cm}$

c) To calculate the area of the shape you must break it up into 3 rectangles as shown in the diagram below:



$A = (80 \times 25) + (15 \times 20) + (10 \times 20)$

$= 2\,000 + 300 + 200$

$= 2\,500\,\text{cm}^2$

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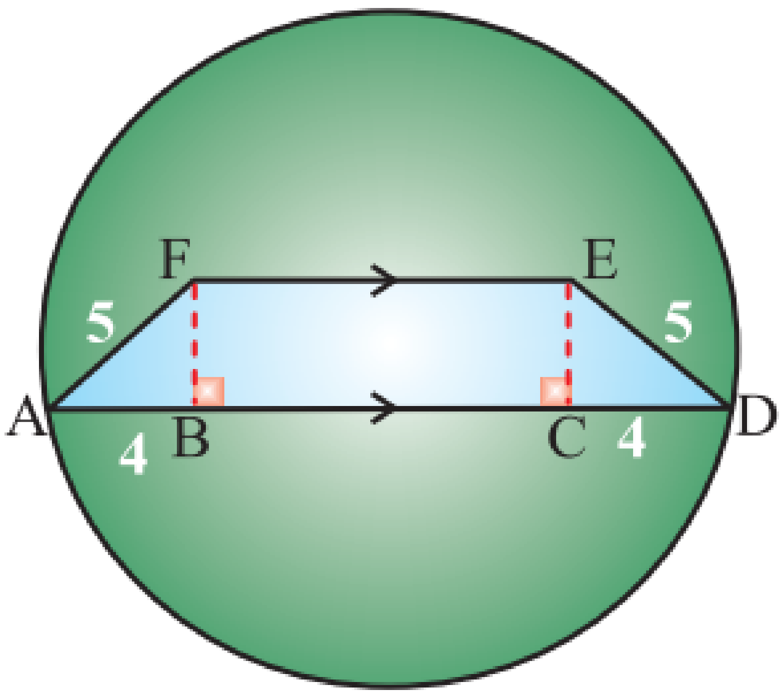
Example 2: **A swimming pool in the shape of trapezium is built in a circular garden as shown below. The garden has a diameter of 40 meters. AF = ED = 5m and AB = CD = 4m. If the longest side of the pool is 16m in length determine the remaining area of the garden (shaded in green below).**



$A_{Garden} = A_{\bigcirc} - A_{\square}$

To calculate the area of the **trapezium**, you must **calculate the length of AD** and **FE** (the parallel sides) as well as the **perpendicular height** (FB or EC).

$AB + BC + CD = AD$

$4 + BC + 4 = 16 \rightarrow$ the longest side of the trapezium is 16m

$BC = FE = 8 \rightarrow$ opp. sides of a rectangle are =

$EC^2 = ED^2 - CD^2 \rightarrow$ pythag

$= 5^2 - 4^2$

$= 9$

$\therefore EC = 3\,\text{m}$

$A_{\square} = \frac{1}{2}(AD + EF) \times EC$

$= \frac{1}{2}(16 + 8) \times 3$

$= 36\,\text{m}^2$

$A_{\bigcirc} = \pi r^2$

$= \pi (20)^2$

$= 400\pi\,\text{m}^2 \rightarrow$ leave your answer in terms of π until the end to avoid rounding errors

$A_{Garden} = A_{\bigcirc} - A_{\square}$

$= 400\pi - 36$

$= 1220,637061$

$= 1221\,\text{m}^2 \rightarrow$ the question said to give the answer to the nearest square metre

The area of a trapezium can also be calculated by breaking the trapezium up into two triangles and a rectangle. You can then sum the area of each triangle and the rectangle.

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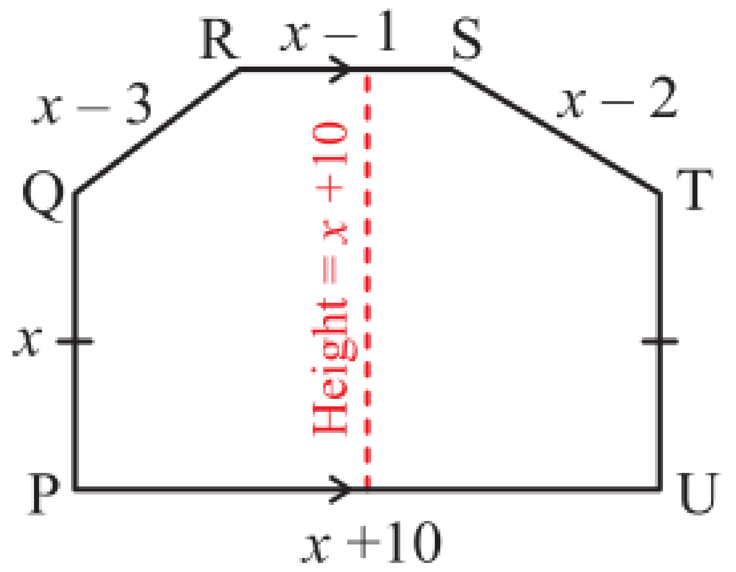
Example 3: PQRSTU is shown below.

a) If the perimeter of PQRSTU is 250cm, determine the value of x.

b) Determine the area of PQRSTU. Give your answer in metres squared and correct to two decimal places.



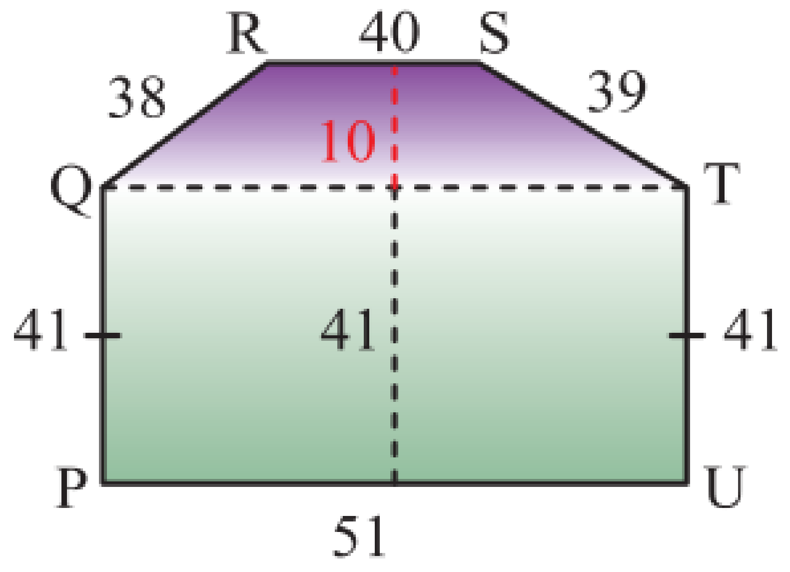
a) $P = x + x - 3 + x - 1 + x - 2 + x + x + 10$

$\therefore 250 = 6x + 4$

$\therefore -6x = -246$

$\therefore x = 41\text{cm}$

b) To calculate the area, you need to break the shape up into a rectangle and trapezium. Note that the perpendicular height of the prism is 10cm.



$A_{PQRSTU} = A_{rectangle} + A_{trapezium}$

$A_{rectangle} = 51 \times 41$

$= 2091\text{cm}^2$

$A_{trapezium} = \frac{1}{2}(51 + 40)(10)$

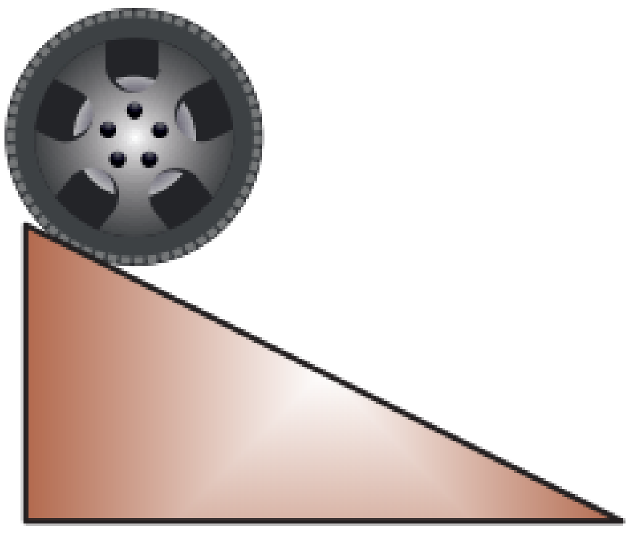
$= 455\text{cm}^2$

$\therefore A_{PQRSTU} = 455 + 2091$

$= 2546\text{cm}^2 \rightarrow$ divide by 10000

$= 0{,}25\text{m}^2$

Example 4: A tyre with a diameter of 0,5m rolls down a hill. The tyre does 20 full revolutions to reach the bottom of the slope. How long is the slope?



$C = \pi d$

$= \pi(0{,}5) \rightarrow$ everytime the tyre completes one revolution it covers a distance of $\pi(0{,}5)$

Slope length $= 20(0{,}5)\pi \rightarrow$ the tyre takes 20 revolutions to reach the bottom of the slope

$= 31{,}42\text{m}$

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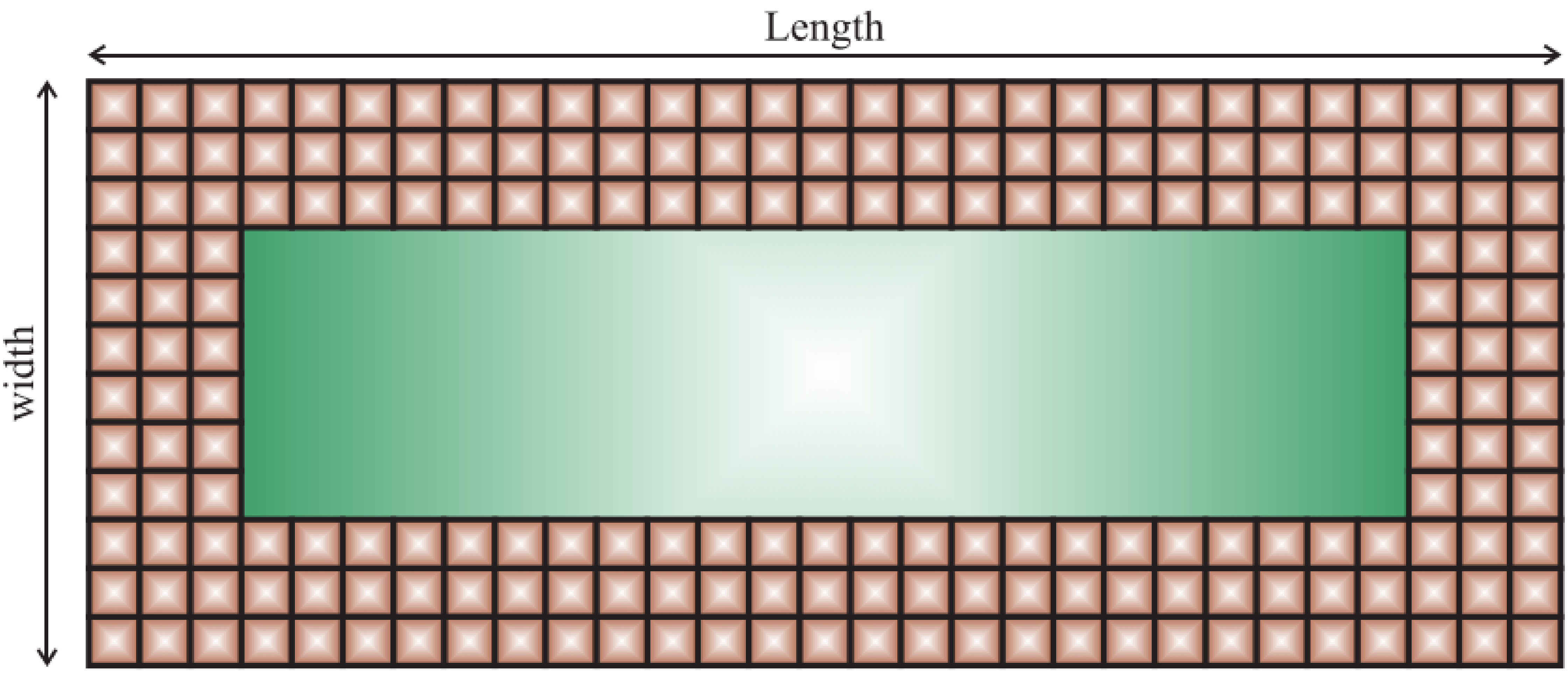
Example 5: A rectangular garden is bordered by square paving bricks. The border is completed by making 3 layers of bricks around the garden.
There are 62 bricks in 1st layer of bricks and 78 bricks in the outermost layer as shown in the diagram below.



a) If the width of the garden is 1,8m, what is the area of a single brick. Give your answer in mm^2.
b) What is the area of the garden?
c) Use your answer from the previous question to determine the area of the brick paving.

a) There are six bricks that run along the width of the garden:

$\therefore$ Length of a brick $= 1,8 \div 6$

$= 0,3\,\text{m}$

$A_{\text{square}} = s^2$

$= 0,3^2$

$= 0,09\,\text{m}^2 \rightarrow \times$ by 1000 000 to convert m^2 to mm^2 ($\times$ by 100 three times)

$= 90\,000\,\text{mm}^2 \rightarrow$ the question said to give your answer in mm^2

b) There are 23 bricks that run along the length of the garden:

Length of garden $= 23(0,3) \rightarrow$ each brick is 0,3m in length

$= 6,9\,\text{m}$

$\therefore \text{Area}_{\text{garden}} = 1,8 \times 6,9 \rightarrow$ length $\times$ breadth

$= 12,42\,\text{m}^2$

c) $\text{Area}_{\text{paving}} = A_{\text{paving+garden}} - A_{\text{garden}}$

$A_{\text{paving+garden}} = 12(0,3) \times 29(0,3) \rightarrow$ 12 paving bricks in width and 29 bricks in length

$= 31,32\,\text{m}^2$

$\therefore \text{Area}_{\text{paving}} = A_{\text{paving+garden}} - A_{\text{garden}}$

$= 31,32 - 12,42$

$= 18,9\,\text{m}^2$

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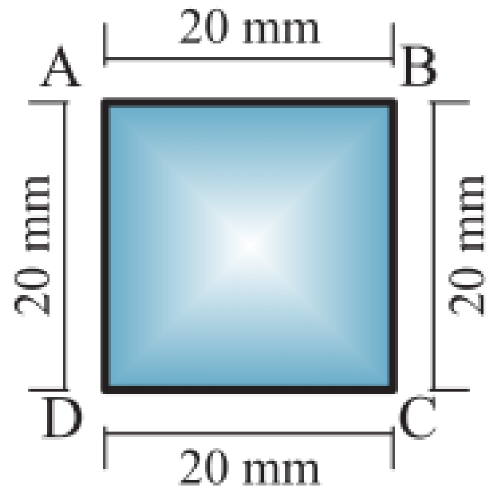
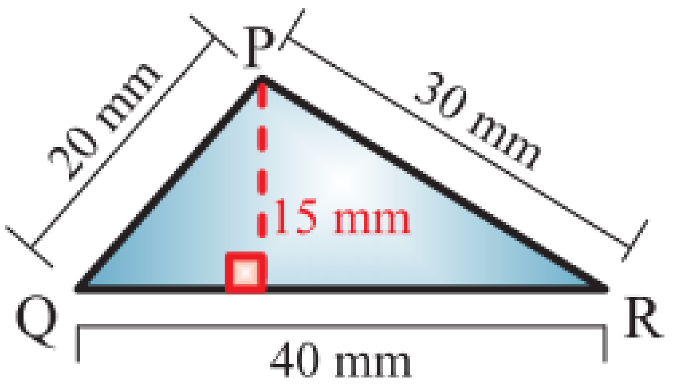
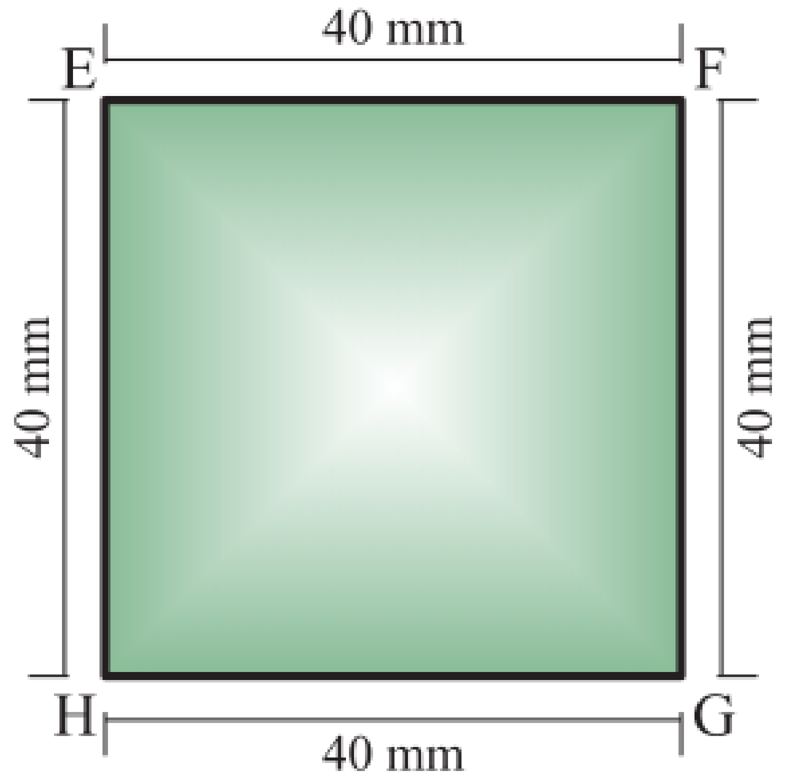
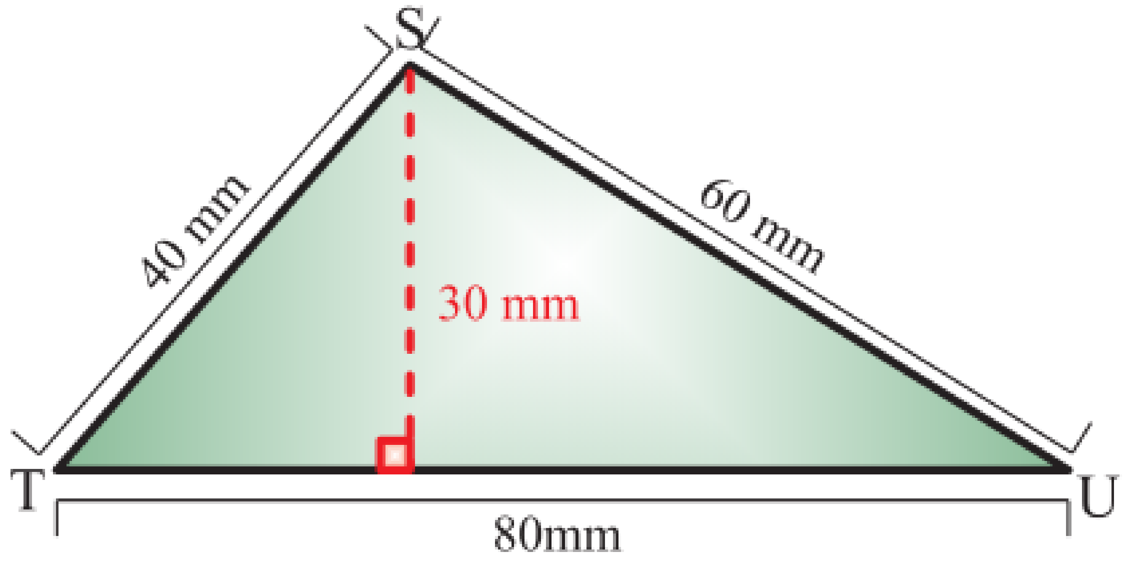
DOUBLING THE DIMENSIONS OF A 2D - SHAPE

Illustrative Example: Determine the perimeter and area of the shapes below.









Perimeter of Small Square	Perimeter of Small Triangle
$P = 4(20) \rightarrow P_{square} = 4s$ $= 80\,\text{mm}$	$P = 40 + 20 + 30$ $= 90\,\text{mm}$
Perimeter of Large Square	**Perimeter of Large Triangle**
$P = 4(40) \rightarrow P_{square} = 4s$ $= 160\,\text{mm} \rightarrow 160 = 80 \times 2$	$P = 80 + 40 + 60$ $= 180\,\text{mm} \rightarrow 180 = 90 \times 2$

Area of Small Square	Area of Small Triangle
$A = \text{Length} \times \text{breadth}$ $= 20 \times 20$ $= 400\,\text{mm}^2$	$A = \frac{1}{2}(\text{base}) \times \perp \text{Height}$ $= \frac{1}{2}(40)(15)$ $= 300\,\text{mm}^2$
Area of Large Square	**Area of Large Triangle**
$A = \text{Length} \times \text{breadth}$ $= 40 \times 40$ $= 1600\,\text{mm}^2 \rightarrow 1600 = 400 \times 4$	$A = \frac{1}{2}(\text{base}) \times \perp \text{Height}$ $= \frac{1}{2}(80)(30)$ $= 1200\,\text{mm}^2 \rightarrow 1200 = 300 \times 4$

From the example, it can be seen that if **all** of the **dimensions** of a 2D shape are **doubled**:

- The **perimeter** of the shape is **doubled**
- The **area** of shape is **multiplied by 4** (increased by a factor of 4)

The above rules only apply if all of the dimensions are doubled.

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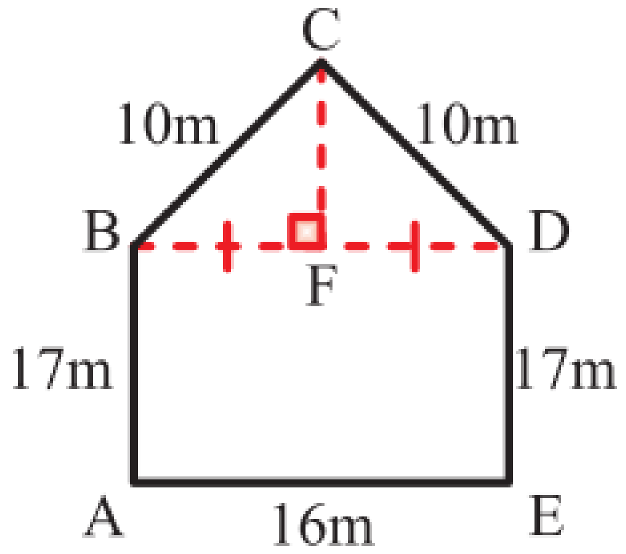
Example: **Examine the diagram below:**



a) **Determine the length of CF.**
b) **Determine the perimeter of ABCDE.**
c) **Determine the area of ABCDE.**
d) **PQRST is formed by doubling all of the dimensions of ABCDE. Determine the ratio of** $\dfrac{\text{Perimeter of PQRST}}{\text{Perimeter of ABCDE}}$.
e) **Determine the** $\dfrac{\text{Area of ABCDE}}{\text{Area of PQRST}}$

a) $CF^2 = BC^2 - BF^2 \rightarrow \text{pythag}$

$= 10^2 - 8^2 \rightarrow BF = \dfrac{AE}{2} = \dfrac{16}{2} = 8$

$= 36$

$\therefore CF = 6\,m$

b) $P_{ABCDE} = 16 + 17 + 10 + 10 + 17$

$= 70\,m$

c) $A_{\square} = 17 \times 16$ and $A_{\triangle} = \dfrac{1}{2}(16)(6) \rightarrow \text{CF is the } \perp \text{ height}$

$= 272\,m^2$ $\quad = 48\,m^2$

$A_{ABCDE} = A_{\square} + A_{\triangle}$

$= 272 + 48$

$= 320\,m^2$

d) $P_{PQRST} = 2(70) \rightarrow \text{doubling all of the dimensions doubles the perimeter}$

$= 140\,m$

$\therefore \dfrac{\text{Perimeter of PQRST}}{\text{Perimeter of ABCDE}} = \dfrac{140}{70}$

$= 2$

e) $A_{PQRST} = 4(320) \rightarrow \text{doubling all of the dimensions multiplies the area by 4}$

$= 1280\,m^2$

$\therefore \dfrac{\text{Area of ABCDE}}{\text{Area of PQRST}} = \dfrac{1280}{320}$

$= 4$

Complete the Mixed Exercise on pages 344 - 345.

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REVISION BOOKLET

TERM 2

2024

GRADE 12

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...

A. eliminate unfair discrimination and promote equal opportunities for all.

B. improve employment opportunities of disadvantaged people.

C. transform South African companies by encouraging black management.

D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

AI CAPS

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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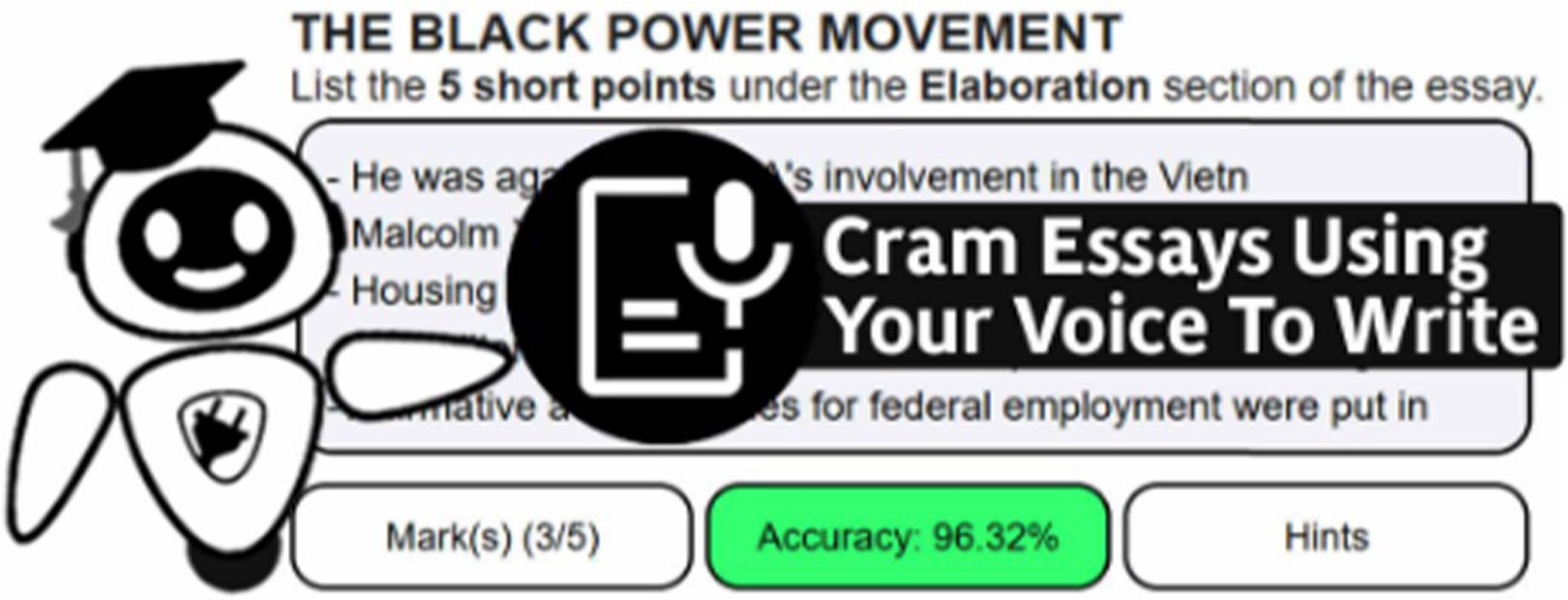

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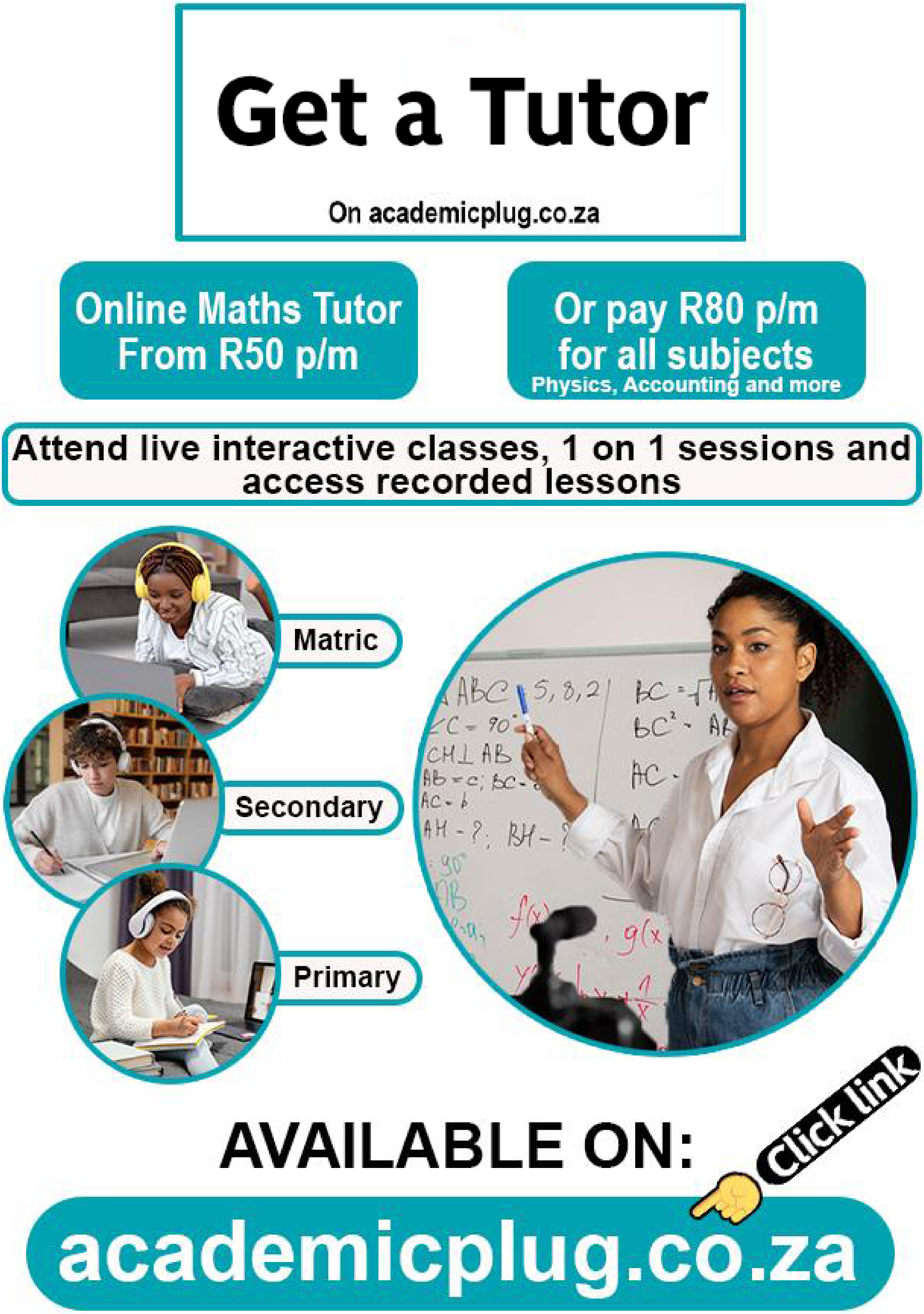
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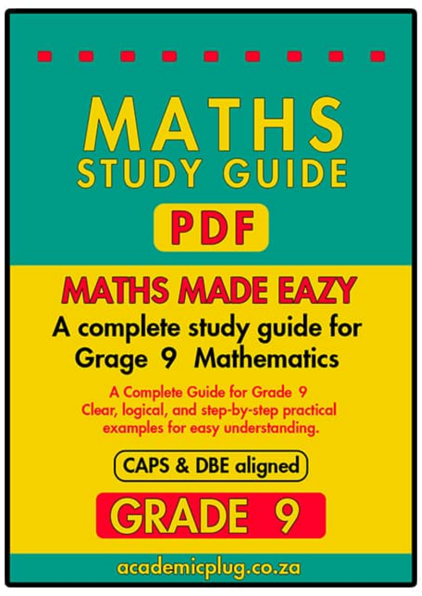

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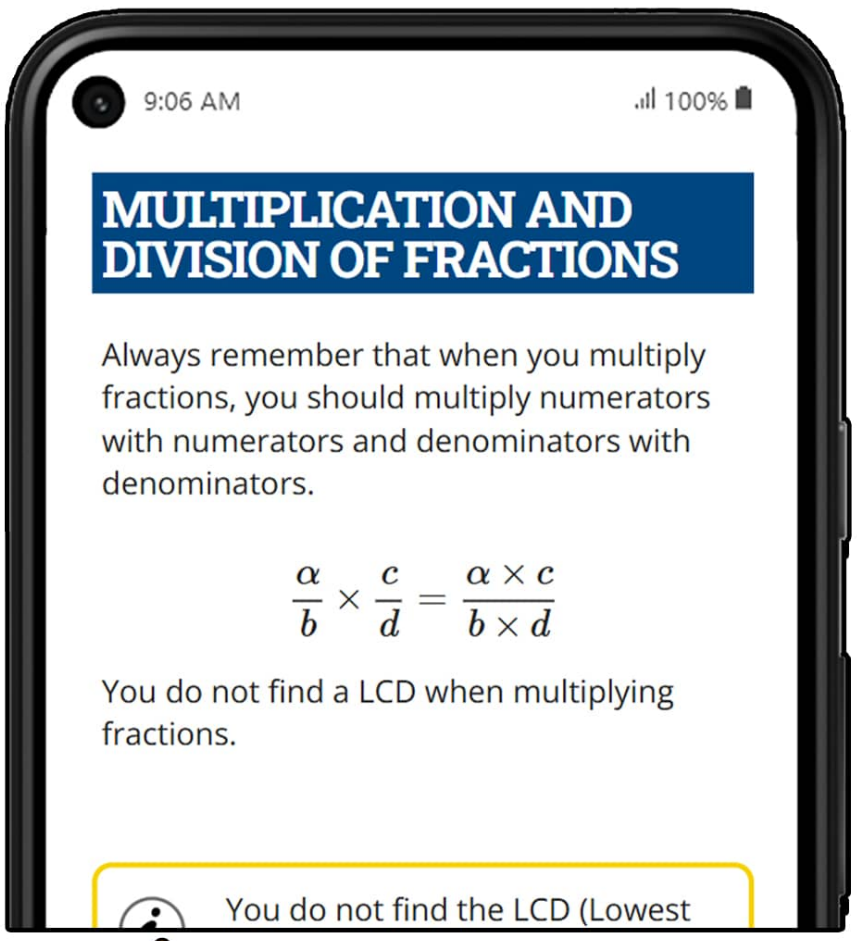

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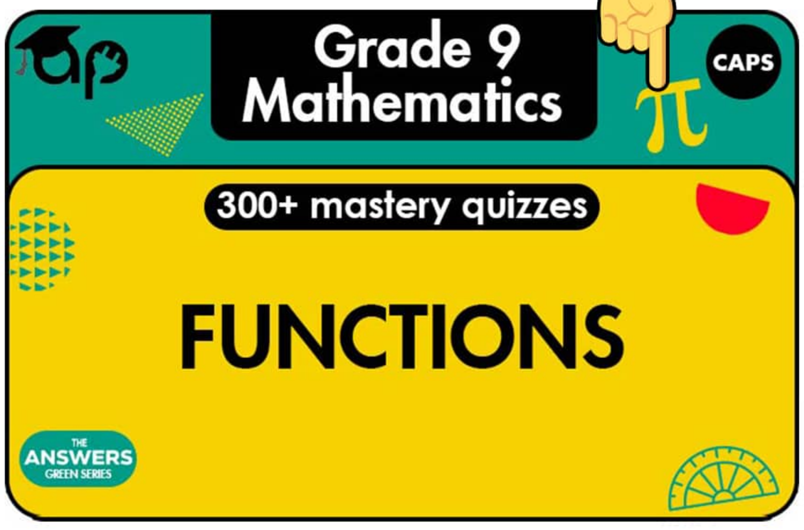

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CHAPTER 16 – FUNCTIONS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
161	**A. Grade 8 revision**	2.2	• Analyse and interpret global graphs of problem situations
164	**B. Horizontal and Vertical Lines**		• Draw global graphs from given descriptions of a problem situation
164	• Horizontal Lines		• Use tables of ordered pairs to plot points and draw graphs on the Cartesian plane
164	• Vertical Lines		• Draw linear graphs from given equations
165	**C. The Straight Line Graph (Linear Function)**		• Determine equations from given linear graphs
165	• The Table Method		
166	• The Dual Intercept Method		
168	• The Gradient Intercept Method		
170	**D. Determining the Gradient of a Straight Line**		
174	**E. Determining the Equation of a Straight Line**		
174	• Case 1: Given the *y-intercept* and one other point		
175	• Case 2: Given any two points		
176	**F. Extension**		
176	• Parallel Lines		
177	• Perpendicular Lines		

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A. GRADE 8 REVISION

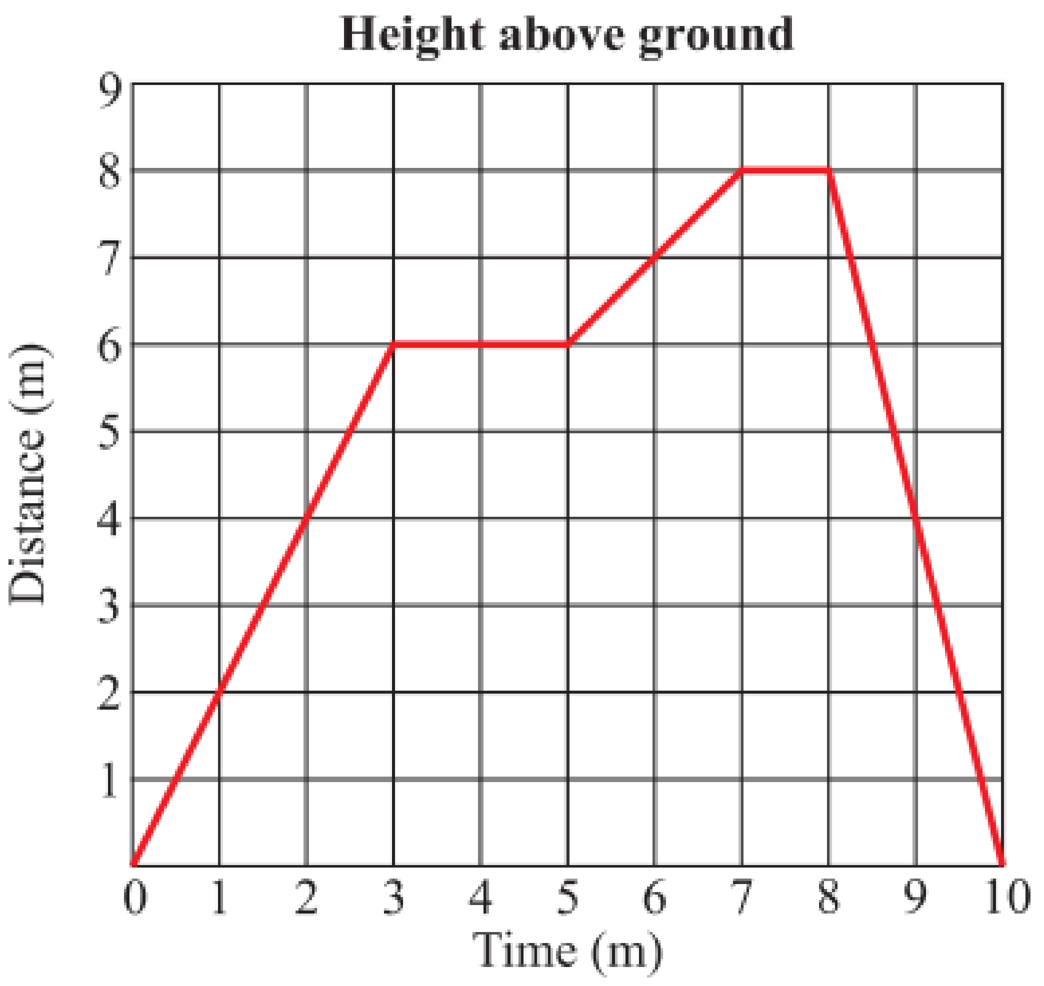
Recap:

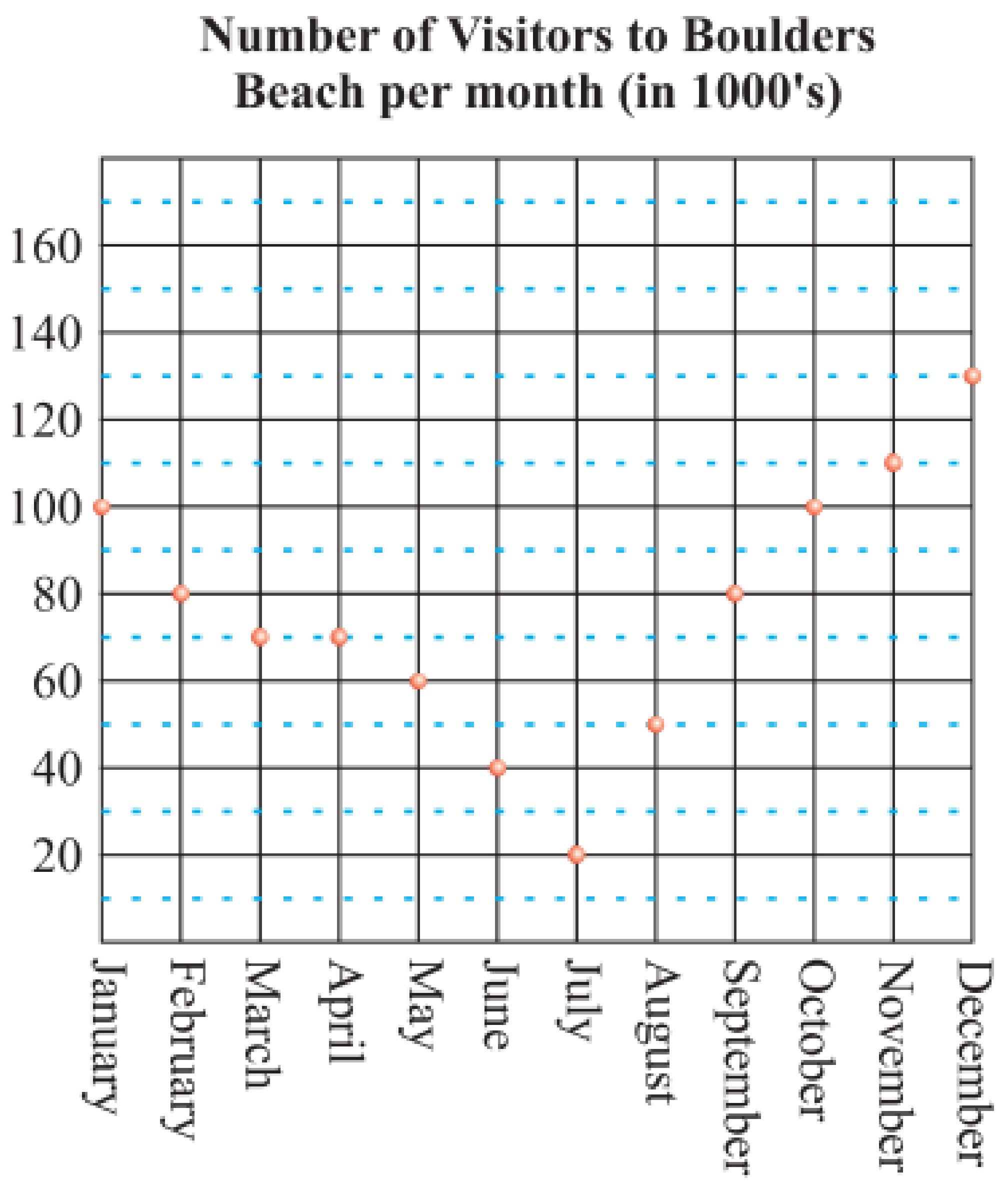
Continuous data is data which can be measured such as distance and temperature. Discrete data is data which can be counted such as number of people on a bus or number of goals scored in a soccer match.

A graph is increasing if as x increases, y also increases.

It is decreasing if as x increases, y decreases.

<u>Example 1</u>: James visits Boulders Beach with his family. Boulders Beach is a popular beach in Simon's Town where visitors can view colonies of penguins from the beach. After visiting the beach, James spends 10 minutes taking photos of the area and penguins using a drone. The graphs shown below represent the height above the ground while James is taking photos and the number of visitors to the beach each month of a certain year.





a) Which graph is continuous and which graph is discrete?
b) Which month had the most number of visitors to the beach?
c) Between which times is the height above the ground increasing?
d) Between which times is the height above the ground decreasing?
e) How many people visited the beach in July?
f) In which month were there 50 000 visitors to the beach?
g) During which times was the drone hovering in one position?

a) The graph of the height of the drone above the ground is continuous and the graph showing the number of visitors to boulders beach is discrete.

b) December.

c) Between 0 and 3 minutes and then again between 5 and 7 minutes.

d) Between 8 and 10 minutes.

e) 20 000.

f) August.

g) Between 3 and 5 minutes and then again between 7 and 8 minutes.

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Example 2: **Given the function $y = 2x + 3$, answer the following questions:**

a) Determine the value of y, if $x = 2$.
b) Determine the value of x, if $y = 23$.

a) Substitute $x = 2$ into the equation:

$$y = 2(2) + 3$$
$$= 7$$

b) Substitute $y = 23$ into the equation:

$23 = 2x + 3 \rightarrow$ take 3 to the LHS

$\therefore 20 = 2x \rightarrow$ divide both sides by 2

$\therefore x = 10$

It is important to understand that in the equation above, the y - value is equal to two times the x – value plus 3.

Example 3: **Given the function $y = x + 1$.**

a) Use the equation to complete the table below:

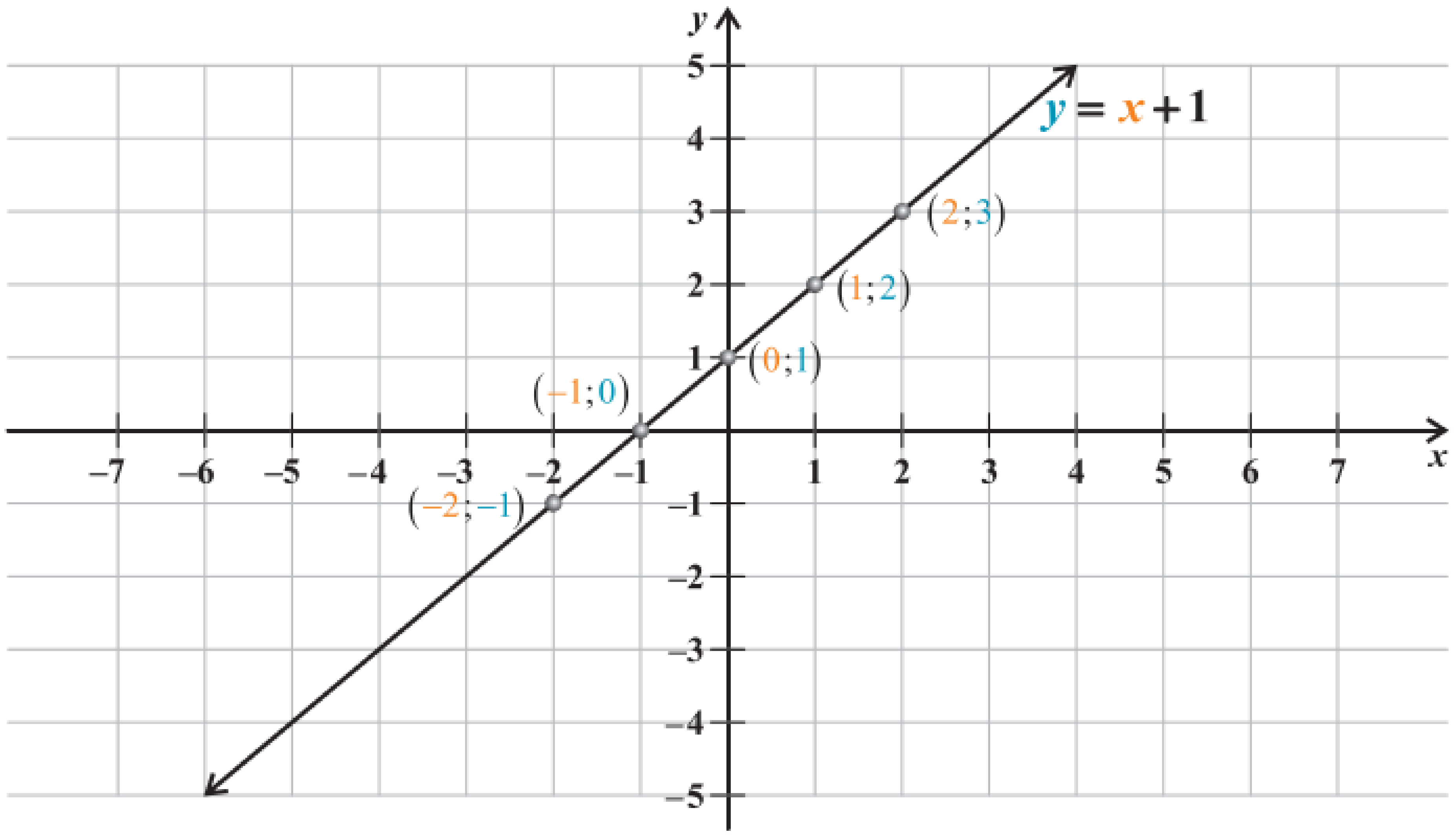
x	–2	–1	0	1	2
y					

b) Using your table plot the graph on the Cartesian plane.

a)

x	–2	–1	0	1	2
y	$y=-2+1$ –1	$y=-1+1$ 0	$y=0+1$ 1	$y=1+1$ 2	$y=2+1$ 3

b)



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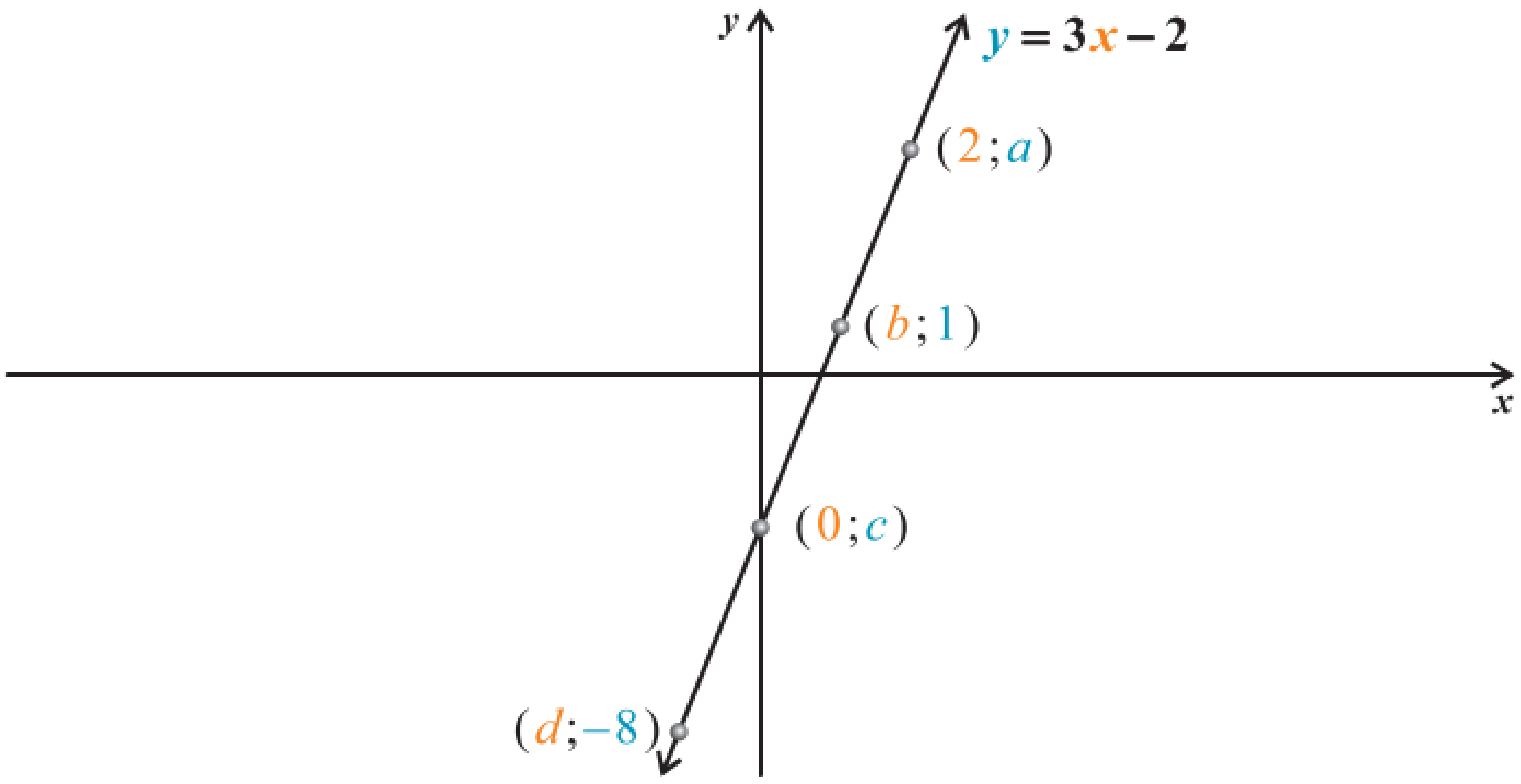
Example 4: **The straight line graph of $y = 3x - 2$ is sketched below. Use the equation to determine value of *a*, *b*, *c* and *d*.**



When $x = 2$, $y = a$. In order to determine the value of ***a*** substitute the point (**2** ; ***a***) into the equation of the line:

$a = 3(2) - 2$

$= 4$

$\therefore a = 4$

When $x = b$, $y = 1$. In order to determine the value of ***b*** substitute the point (***b*** ; **1**) into the equation of the line:

$1 = 3b - 2 \rightarrow$ move the -2 to the RHS

$\therefore 3 = 3b \rightarrow$ divide both sides by 3

$\therefore 1 = b$

$\therefore b = 1$

When $x = 0$, $y = c$. In order to determine the value of ***c*** substitute the point (**0** ; ***c***) into the equation of the line:

$c = 3(0) - 2$

$= -2$

$\therefore c = -2$

When $x = d$, $y = -8$. In order to determine the value of ***d*** substitute the point (***d*** ; **– 8**) into the equation of the line:

$-8 = 3d - 2 \rightarrow$ move the -2 to the RHS

$-6 = 3d \rightarrow$ divide both sides by 3

$\therefore -2 = d$

$\therefore d = -2$

If you are given an *x*-value on a graph, the corresponding *y*-value can always be found by substituting the given *x*-value into the equation of the graph and solving for *y*.

If you are given a *y*-value on a graph, the corresponding *x*-value can always be found by substituting the given *y*-value into the equation of the graph and solving for *x*.

Complete Exercise 1 on page 350.

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B. HORIZONTAL AND VERTICAL LINES

HORIZONTAL LINES

The y-value on a horizontal line does not change.
The **equation** of a **horizontal line** is always in the form:

$$y = k$$

where k is a constant (a number)

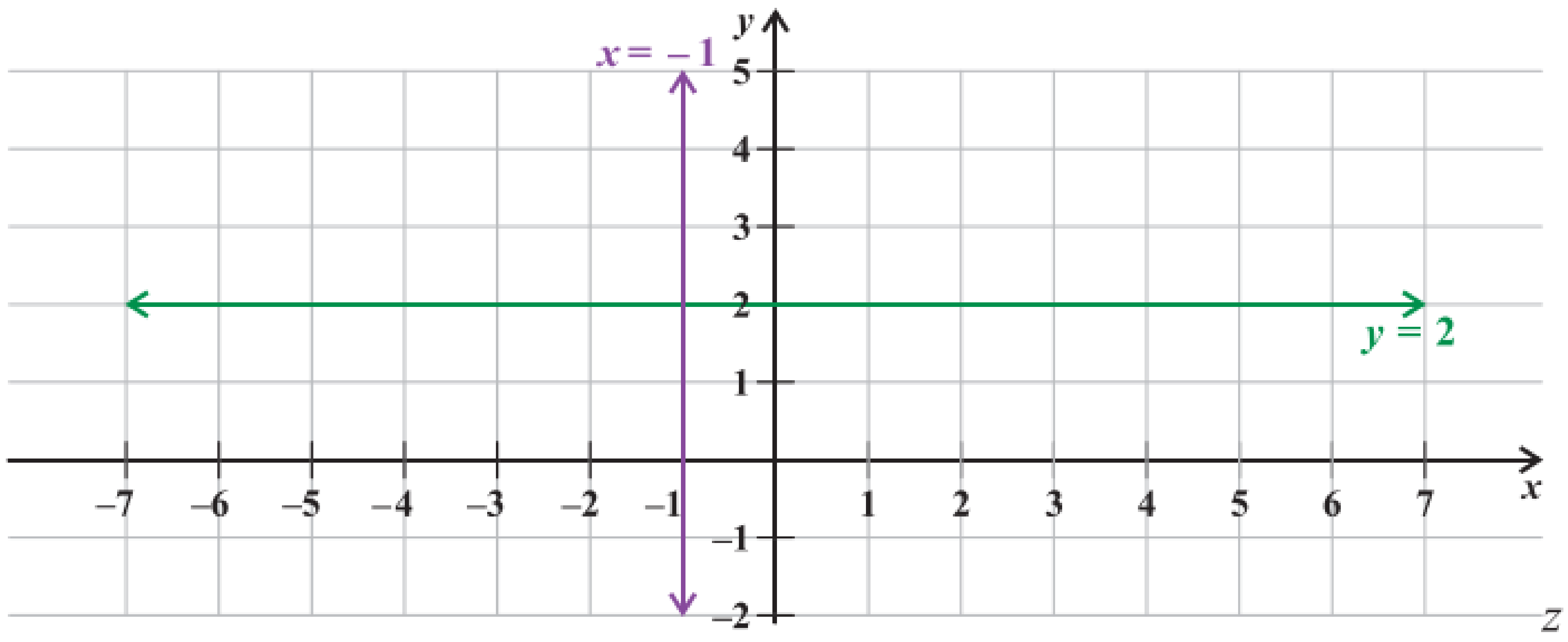
VERTICAL LINES

The x-value on a vertical line does not change.
The **equation** of a **vertical line** is always in the form:

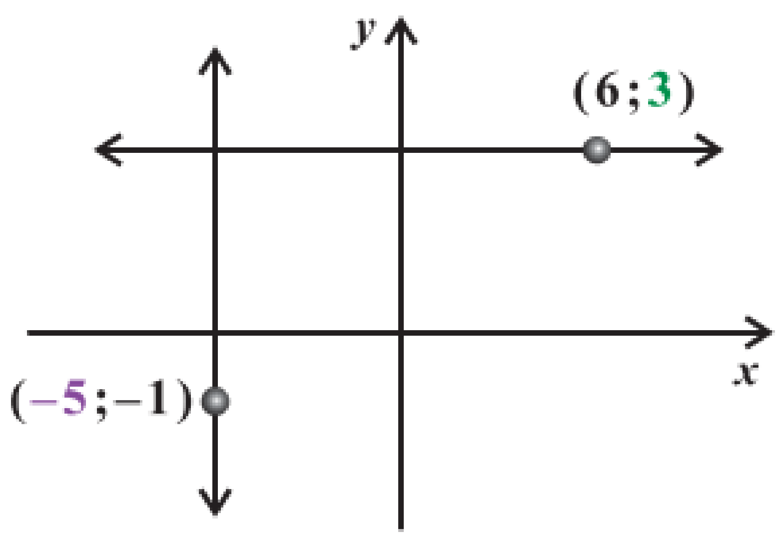
$$x = k$$

where k is a constant (a number)

Example 1: **Sketch the lines of $y = 2$ and $x = -1$ on the same set of axes.**



Example 2: **A horizontal and vertical line are shown below. Determine the equations of the lines**



Horizontal Line

The y-value of a horizontal line does not change. Therefore, the equation of the horizontal line is:

$y = 3$

Vertical Line

The x-value of a vertical line does not change. Therefore, the equation of the vertical line is:

$x = -5$

Complete Exercise 2 on pages 350 and 351.

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C. THE STRAIGHT LINE GRAPH (LINEAR FUNCTION)

The **straight line graph** or **linear function** has the form:

$$y = mx + c$$

Where: m → **gradient**
c → **y-intercept**

There are 3 methods which can be used to sketch a straight line graph:

1. **The table method**
2. **The dual intercept method**
3. **The gradient intercept method**

It is important to understand that in the equation above, y and x are points in the Cartesian plane.

1. THE TABLE METHOD

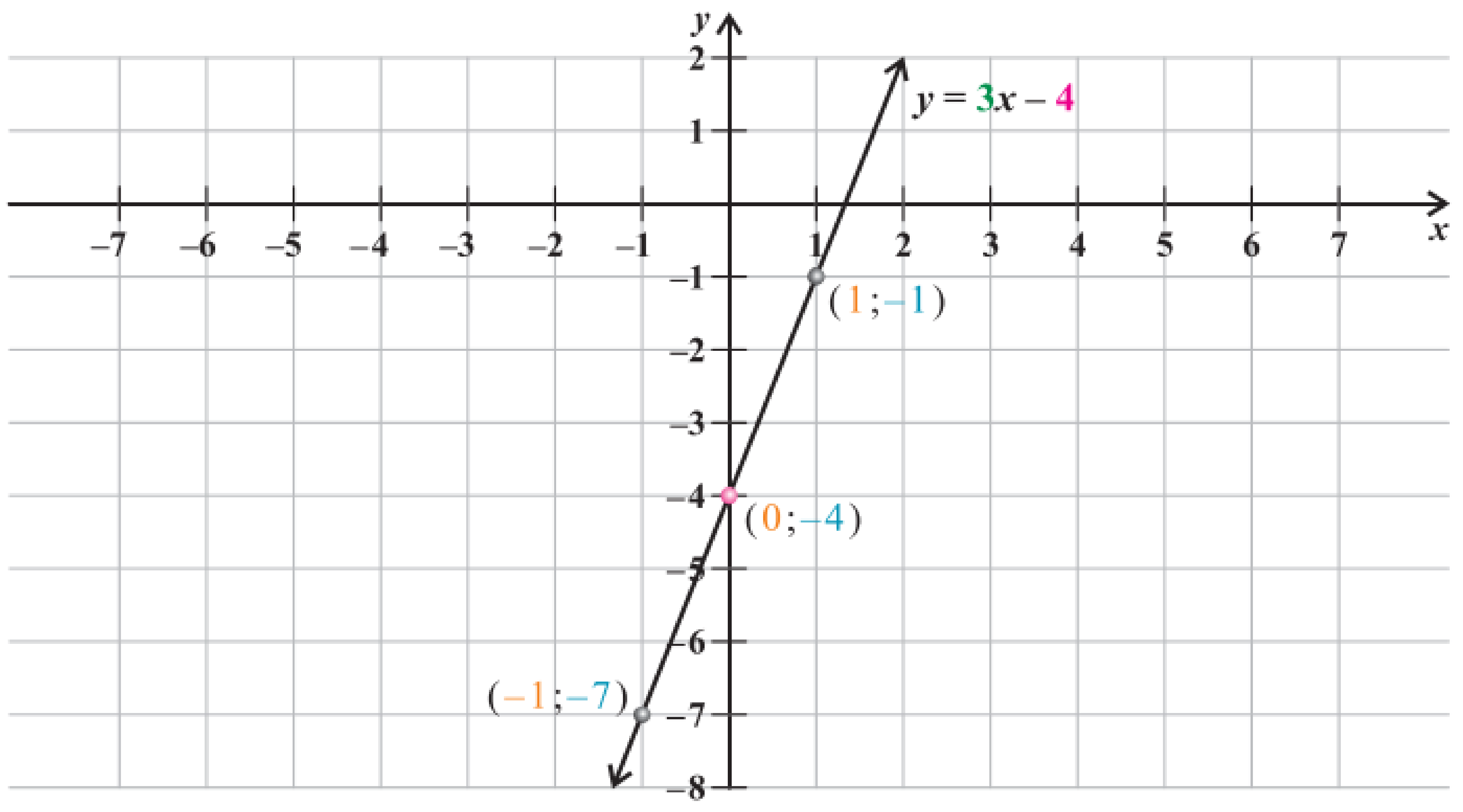
In this method, you use a table and substitute values for x into the equation in order to calculate what the corresponding y-value would be at that specific point.
You can choose any values to substitute for x. However, one number on either side of zero is usually sufficient.

Example 1: Sketch the graph of $y = 3x - 4$ using the table method.

Create a table as shown below:

x	-1	0	1
y	$y=3(-1)-4$ -7	$y=3(0)-4$ -4	$y=3(1)-4$ -1

Now plot the x and y coordinates in the table:



When drawing straight line graphs, join the points with a ruler and draw arrow heads on the end of your line to show that the graph continues forever.
You should also label your graph with the equation as shown above.

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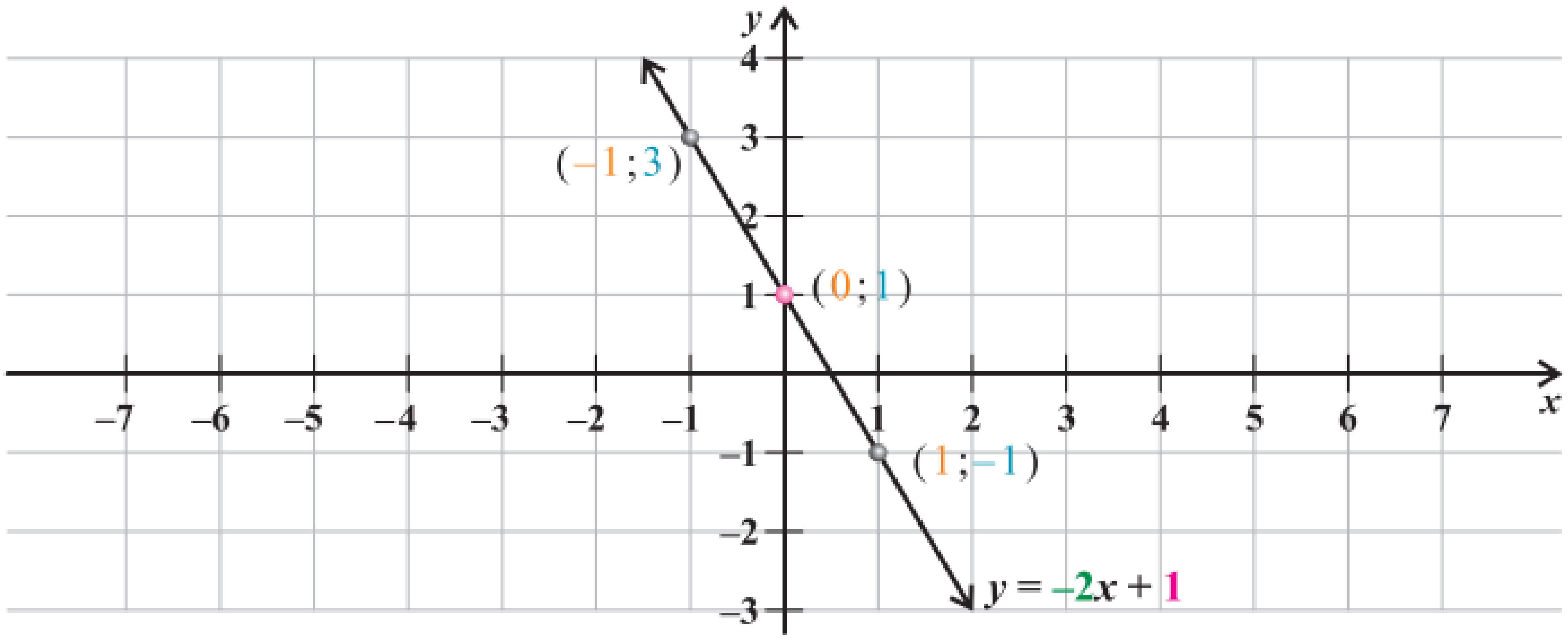
<u>Example 2</u>: Sketch the graph of $y = -2x + 1$ using the table method.

Create a table as shown below:

x	-1	0	1
y	$y=-2(-1)+1$ 3	$y=-2(0)+1$ 1	$y=-2(1)+1$ -1

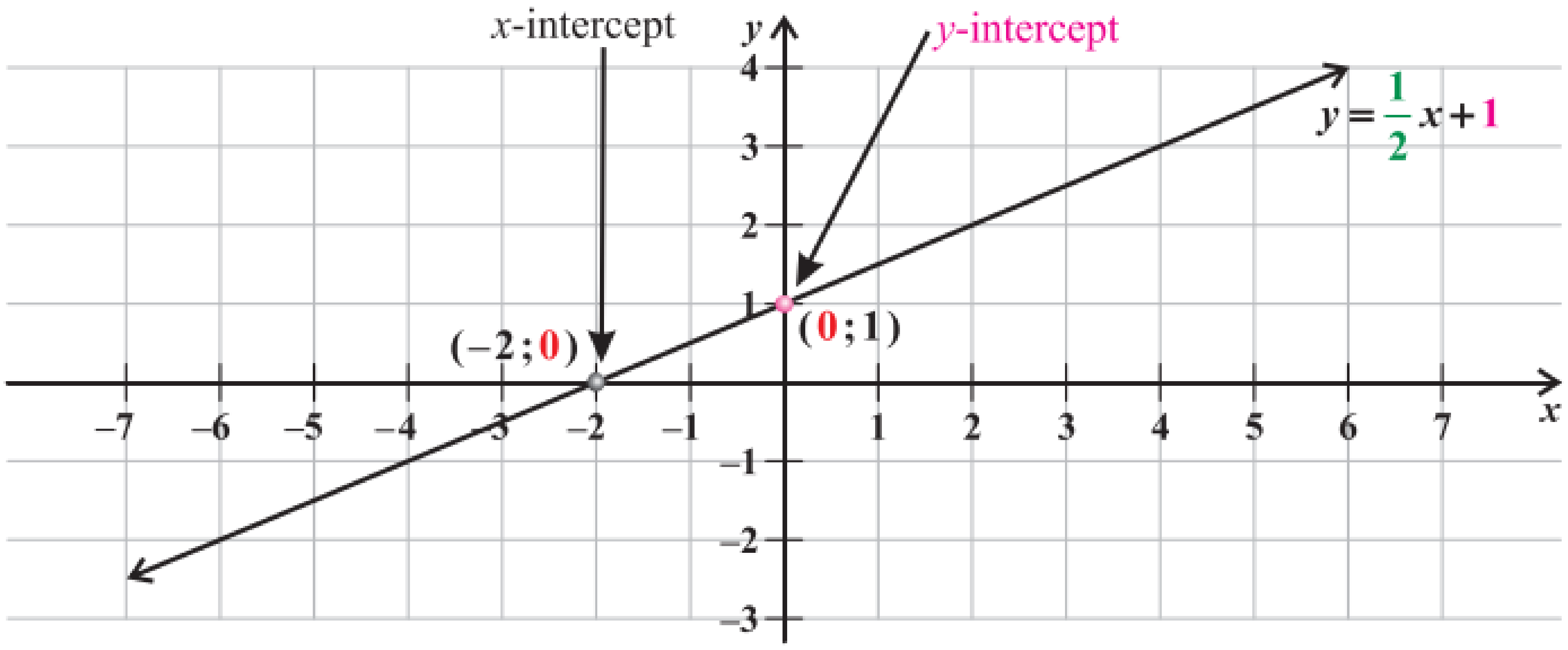
Now plot the x and y coordinates in the table:



Complete Exercise 3 number 1 on page 351.

2. THE DUAL INTERCEPT METHOD

Before sketching a graph using this method, it is important you understand the concept of an **x and y - intercept**. Examine the straight line graph of $y = \frac{1}{2}x + 1$ drawn below.



The ***x*-intercept** is the point where the **graph cuts the *x*-axis**.
The ***y*-value** at the ***x*-intercept** is always **equal to 0**.

The ***y*-intercept** is the point where the **graph cuts the y-axis**.
The ***x*-value** at the ***y*-intercept** is always **equal to 0**.

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When sketching Graphs using the **dual intercept method** you must **determine the *x* and *y* - intercepts**. You then draw a line through the intercepts.

To **determine the *x*-intercept**, you **substitute $y = 0$** into the equation of the line. This is because the y-value is always equal to 0 on the x-axis.

To **determine the *y*-intercept**, you **substitute $x = 0$** into the equation of the line. This is because the x-value is always equal to 0 on the y-axis.

The ***y*-intercept** can also be read form the equation of the graph. In the equation $y = mx + c$, c is the y- intercept. Therefore, the point $(0 ; c)$ is the y-intercept.

Example 1: Sketch the graph of $y = 2x - 4$ using the dual intercept method.

x-int: let $y = 0$:

$0 = 2x - 4 \rightarrow y = 0$

$\therefore -2x = -4 \rightarrow$ divide both sides by -2

$\therefore x = 2$

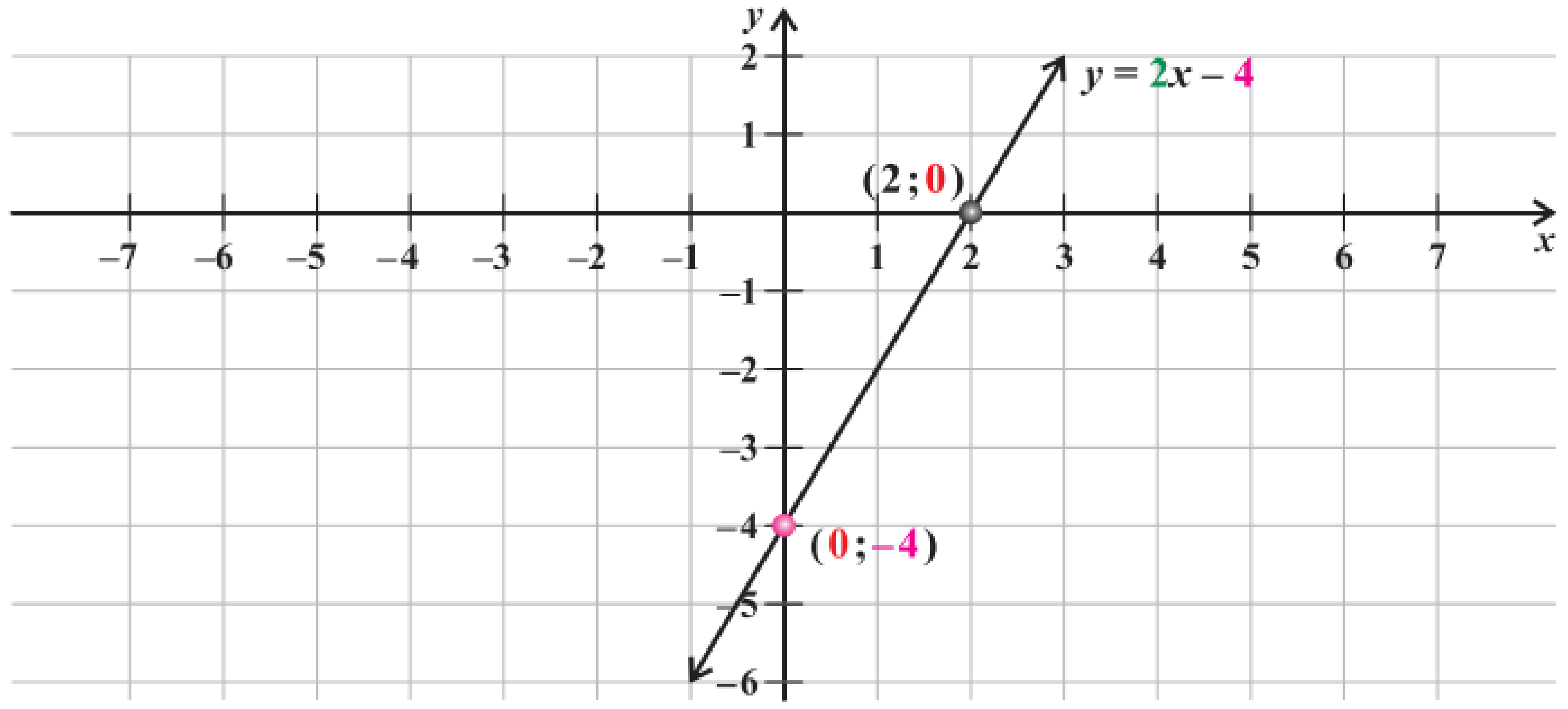
$\therefore$ the x-intercept is the point $(2;0)$

y-int: let $x = 0$:

$y = 2(0) - 4 \rightarrow x = 0$

$= -4$

$\therefore$ the y-intercept is the point $(0;-4)$



Example 2: Sketch the graph of $y = -2x + 2$ using the dual intercept method.

x-int: let $y = 0$:

$0 = -2x + 2 \rightarrow y = 0$

$\therefore 2x = 2 \rightarrow$ divide both sides by 2

$\therefore x = 1$

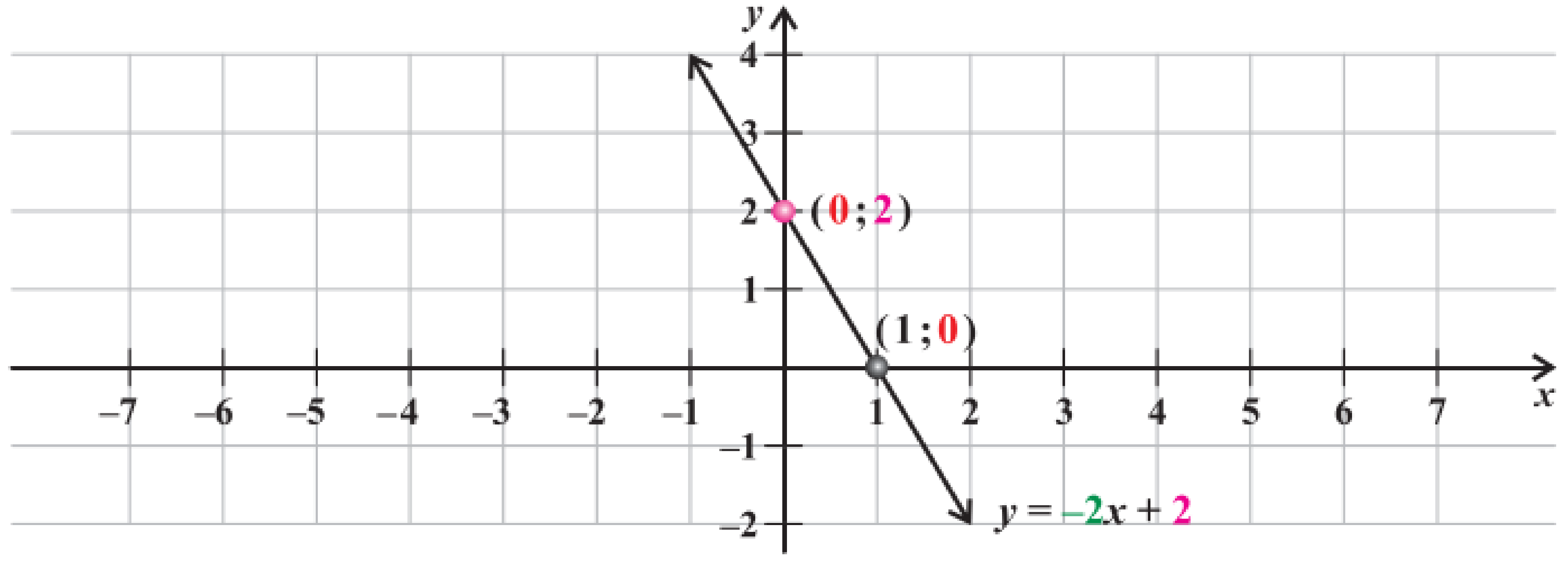
$\therefore$ the x-intercept is the point $(1;0)$

y-int: let $x = 0$:

$y = -2(0) + 2 \rightarrow x = 0$

$= 2$

$\therefore$ the y-intercept is the point $(0;2)$



Complete Exercise 3 number 2 on page 351.

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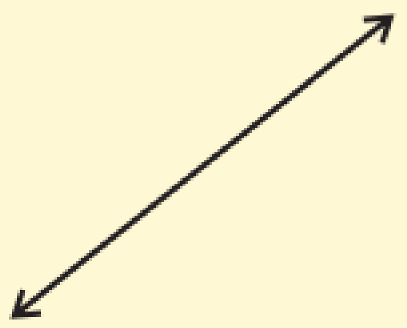
3. THE GRADIENT INTERCEPT METHOD

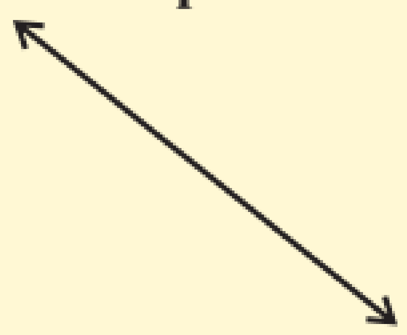
The **gradient (m) of a straight line** is the **slope** or **steepness** of a line.
The gradient is defined as the rate of change of y over the rate of change of x.

If the **gradient** is **positive** the graph will have a **positive slope**:



$m > 0$

If the **gradient** is **negative** the graph will have a **negative slope**:



$m < 0$

Recap:
In the equation $y = mx + c$, m is the gradient.

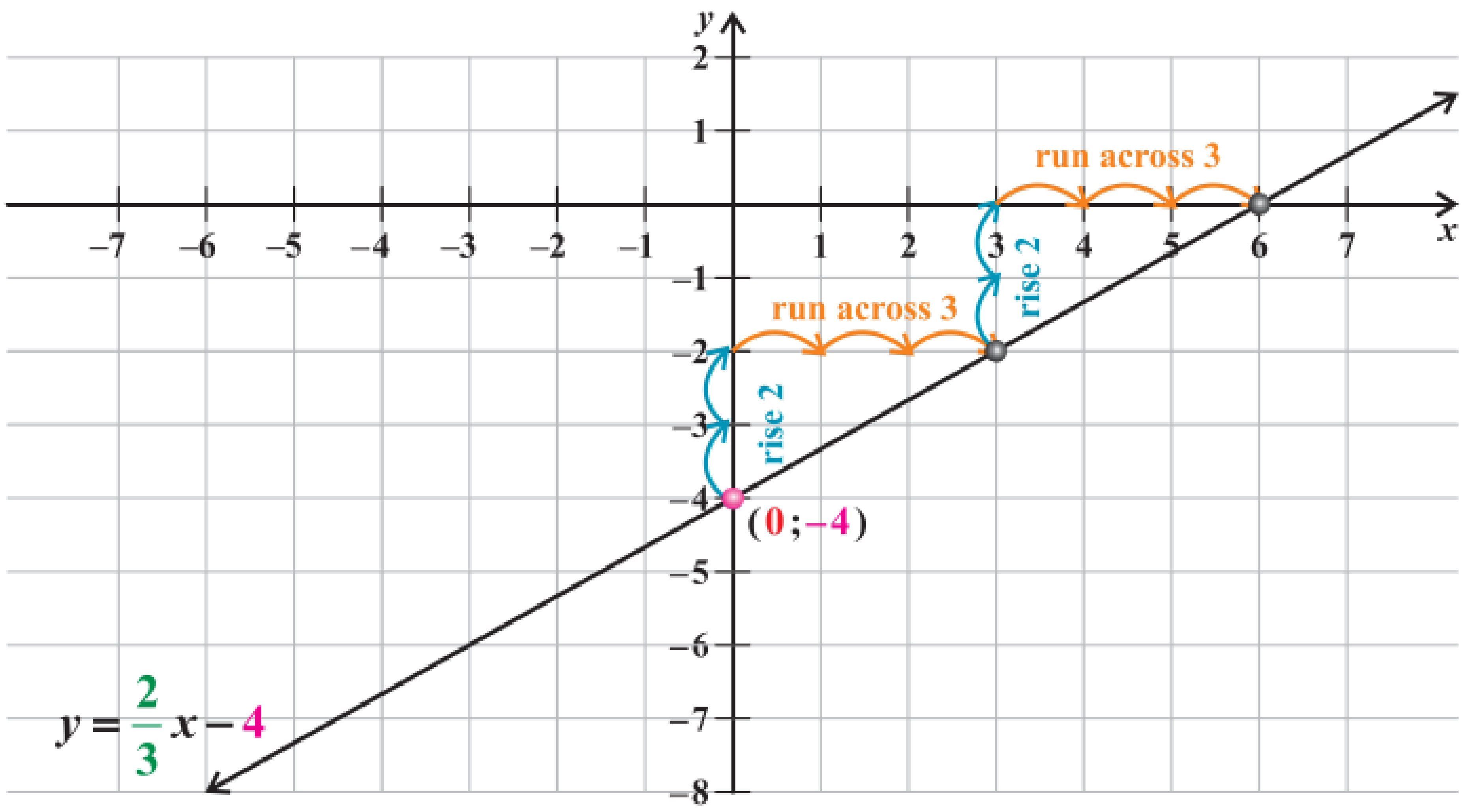
<u>Example 1</u>: Sketch the graph of $y = \frac{2}{3}x - 4$ using the gradient intercept method.

From, the equation of the function the gradient equals to $\frac{2}{3}$.

Another name for the **gradient intercept method** is the **rise over run method**.

So, if the gradient is $\frac{2}{3} \rightarrow \frac{rise}{run}$, to get from one point on the graph to the next point you **rise** 2 units and **run** (move across) 3 units.

Using this method, you **start with the y-intercept**. Therefore, the starting point is $(0;-4)$.
To get to the next point, you rise 2 and run across 3 units. This is shown on the graph below.



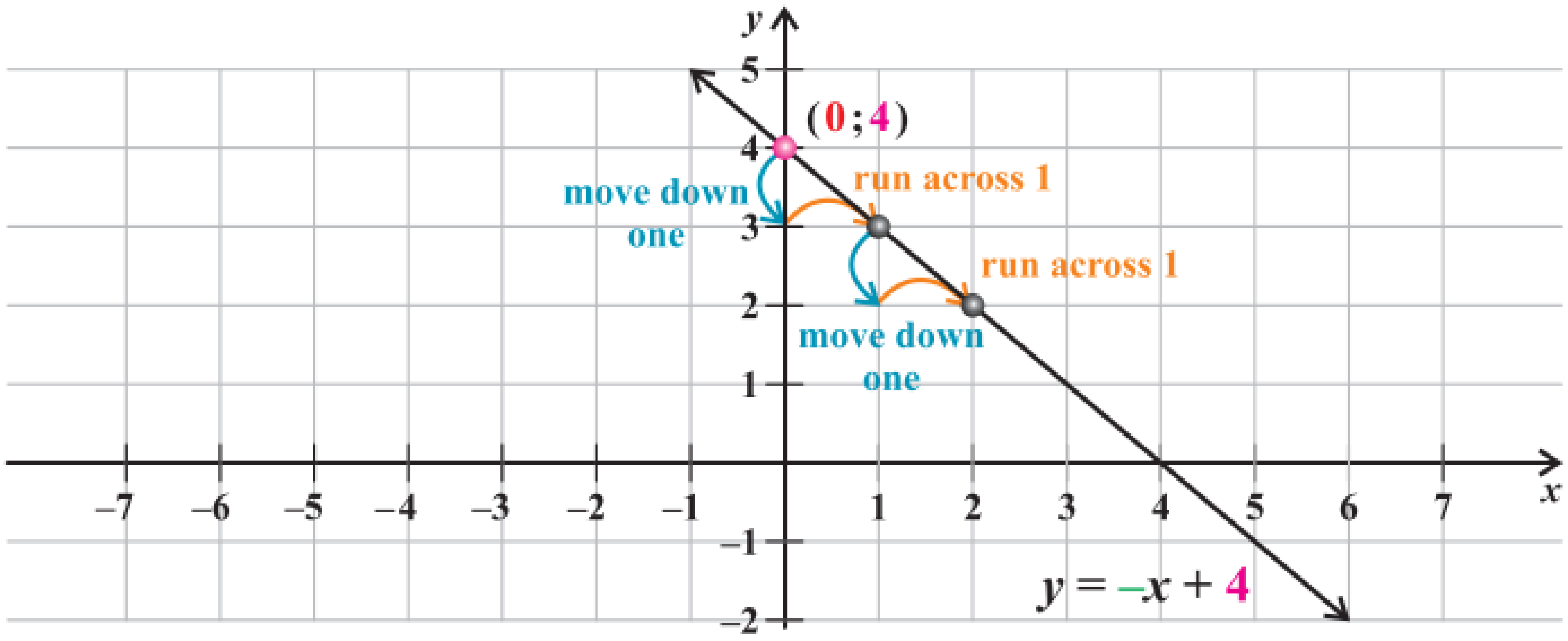
Example 2: **Sketch the graph of $y=-x+4$ using the gradient intercept method.**

From the equation of the function the gradient equals to -1 .

So, if the gradient is $-\frac{1}{1}\rightarrow\frac{rise}{run}$, to get from one point on the graph to the next point you **rise** -1 (move down 1 unit) units and **run** (move across) 1 unit. As the **gradient** is **negative**, instead of moving up, you **move down**.

Using this method, **start with the *y*-intercept**. Therefore, the starting point is $(0;4)$.

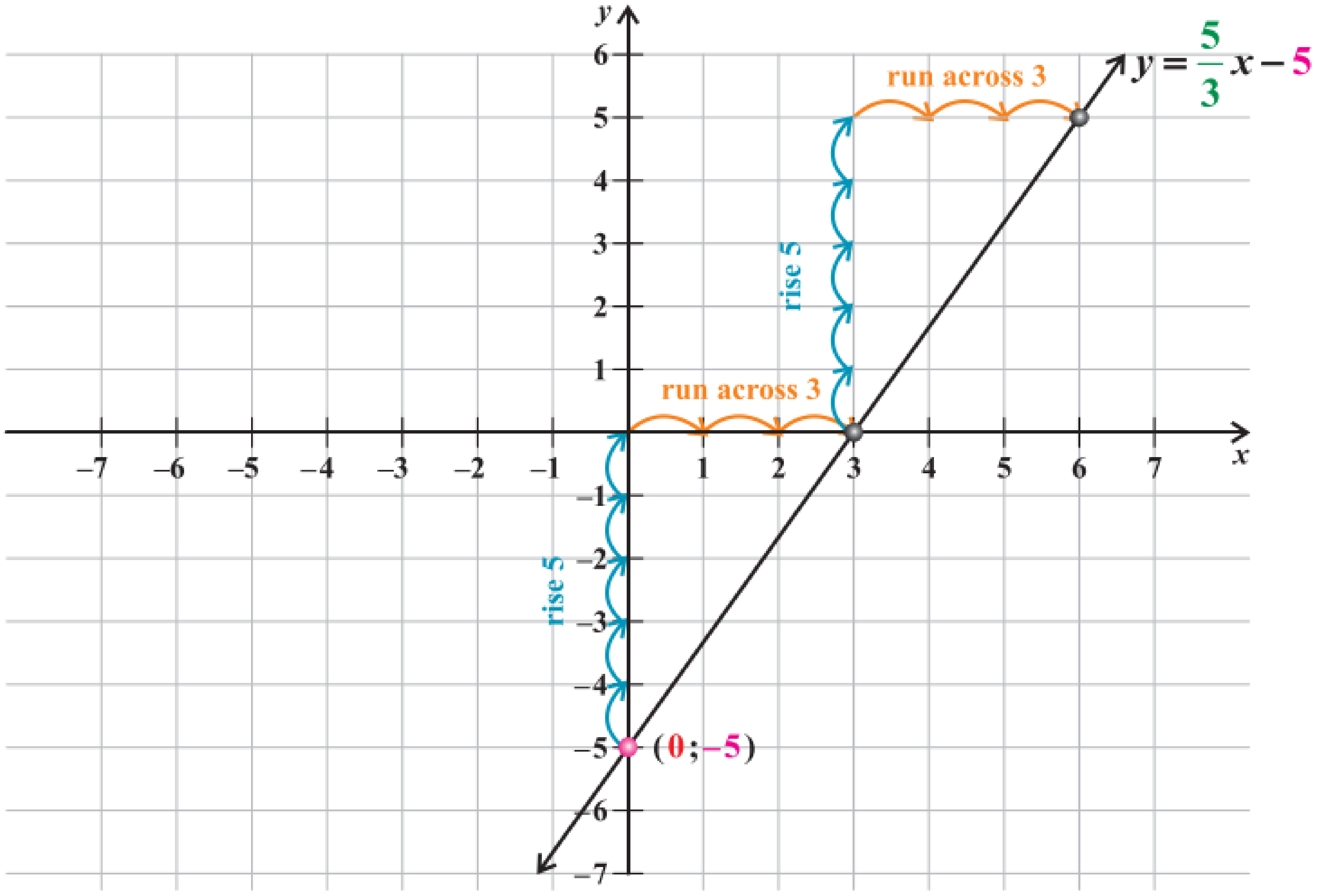
To get to the next point, you move down 1 and run across 1 unit. This is shown on the graph below.



Example 3: **Sketch the graph of $y=\frac{5}{3}x-5$ using the gradient intercept method.**

Starting point: $(0;-5)$

Gradient: $\frac{5}{3}$



Complete Exercise 3 number 3 on page 351.

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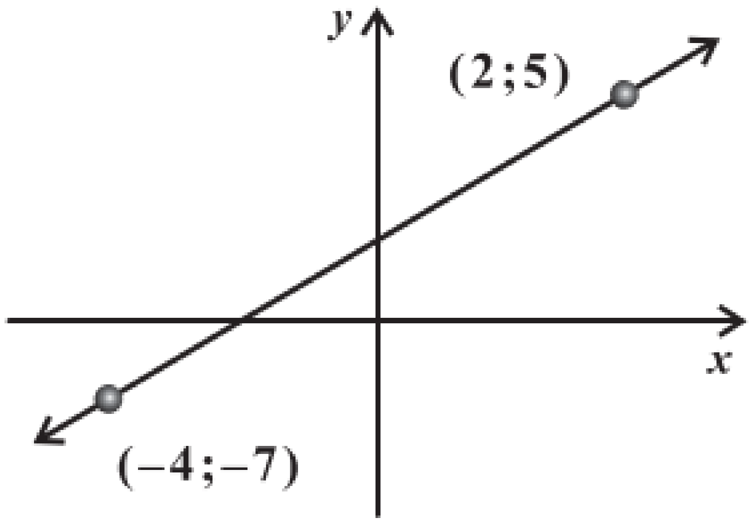
D. DETERMINING THE GRADIENT OF A STRAIGHT LINE

It was seen on page 168 that the **gradient** of a straight line is the **rate of change of y over the rate of change of x**. The formula shown below is used to calculate the gradient of a line using two points on the line.

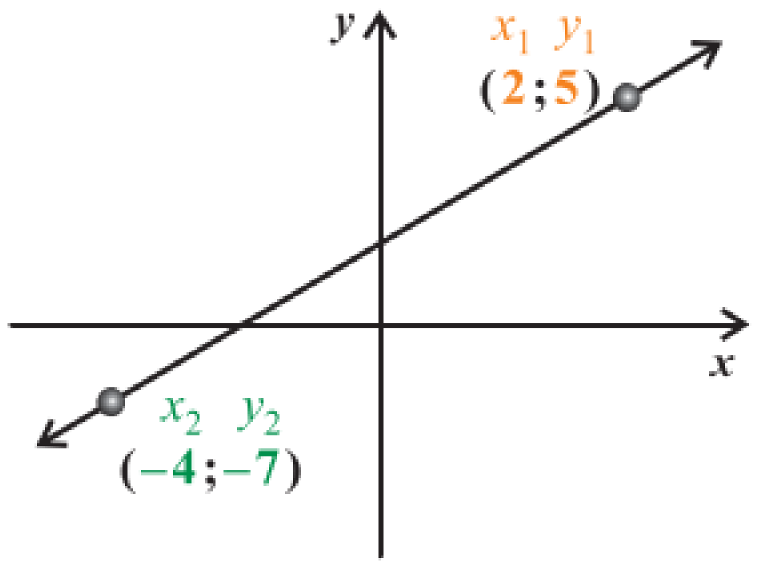
Gradient

$$m = \frac{\triangle y}{\triangle x} = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Example 1: Determine the gradient of the straight line shown below:

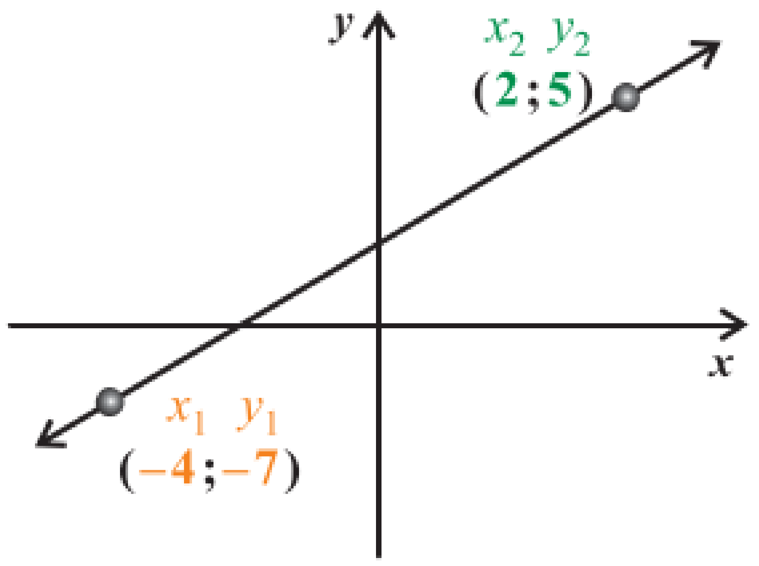


Method 1:



$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-7-5}{-4-2} \\ &= \frac{-12}{-4-2} \\ &= \frac{-12}{-6} \\ &= 2 \end{aligned}$$

Method 2:



$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{5-(-7)}{2-(-4)} \\ &= \frac{5+7}{2+4} \\ &= \frac{12}{6} \\ &= 2 \end{aligned}$$

As can be seen from the above example, it does not matter which point you choose to be x_1 and y_1 or x_2 and y_2. What is important, is that the point you choose must be a pair. In other words, it must be $(x_2 ; y_2)$ and $(x_1 ; y_1)$.

You cannot use a point as $(x_2 ; y_1)$ or $(x_1 ; y_2)$.

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Example 2: **Determine the gradient of a straight line which passes through the points (2;–3) and (5;6).**

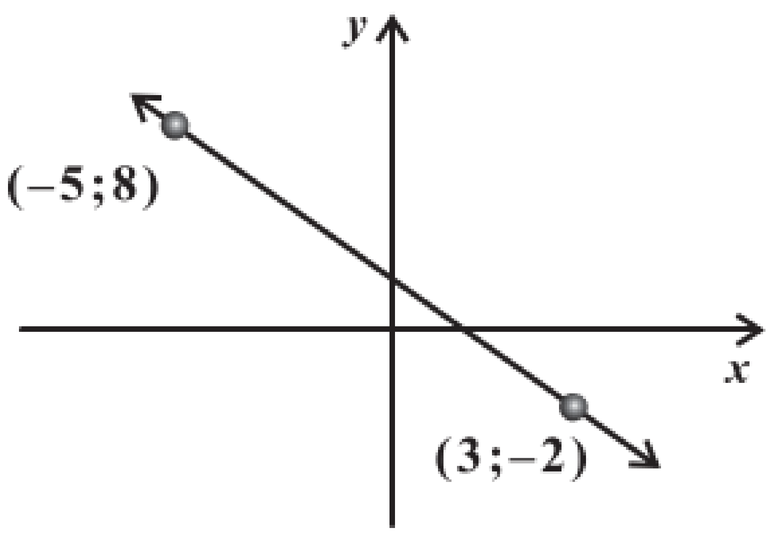
Method 1:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{6-(-3)}{5-2}$$
$$= \frac{6+3}{3}$$
$$= \frac{9}{3}$$
$$= 3$$

Method 2:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{-3-6}{2-5}$$
$$= \frac{-9}{-3}$$
$$= 3$$

Example 3: **Matthew, a Grade 9 learner, was asked to determine the gradient of the straight line graph shown below. His calculations are shown underneath the graph.**



Matthew's answer: $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$= \frac{-2-8}{-5-3}$$
$$= \frac{-10}{-8}$$
$$= \frac{5}{4}$$

a) **Matthew's answer is incorrect. Determine the correct gradient of the graph.**

b) **By looking at the graph, suggest a way that Matthew should have known that his answer was incorrect**

a) $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$= \frac{-2-8}{3-(-5)}$$
$$= \frac{-10}{8}$$
$$= -\frac{5}{4}$$

b) Matthew's answer for the gradient of the line is positive. However, from the graph it can be seen that the slope is negative. Therefore, Matthew could have known his answer was incorrect as the answer should have been negative.

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Example 4: **Determine the gradient of the straight line $y-3x+5=0$.**

To determine the gradient of the line you must write the equation in the form: $y=mx+c$

$y-3x+5=0 \rightarrow$ take the $-3x+5$ to the RHS

$\therefore y=3x-5$

$\therefore$ The gradient of the line is **3**. $\rightarrow$ the gradient (m) is the coefficient of x.

Example 5: **Determine the gradient of the straight line $2y-3x=4$.**

To determine the gradient of the line you must write the equation in the form: $y=mx+c$

$2y-3x=4 \rightarrow$ take the $-3x$ to the RHS

$\therefore 2y=3x+4 \rightarrow$ divide both sides by 2

$$\therefore y=\frac{3}{2}x+\frac{4}{2}$$

$$\therefore y=\frac{3}{2}x+2$$

$\therefore$ The gradient of the line is $\mathbf{\frac{3}{2}}$. $\rightarrow$ the gradient (m) is the coefficient of x.

Example 6: **Determine the gradient of the straight line $\frac{y}{3}+2x=-1$.**

To determine the gradient of the line you must write the equation in the form: $y=mx+c$

$\frac{y}{3}+2x=-1 \rightarrow$ take the $2x$ to the RHS

$\therefore \frac{y}{3}=-2x-1 \rightarrow$ multiply both sides by 3

$\therefore y=-6x-3$

$\therefore$ The gradient of the line is **–6**. $\rightarrow$ the gradient (m) is the coefficient of x.

Example 7: **Determine the gradient of the straight line $5y-15x=0$.**

To determine the gradient of the line you must write the equation in the form: $y=mx+c$

$5y-15x=0 \rightarrow$ take the $-15x$ to the RHS

$\therefore 5y=15x \rightarrow$ divide both sides by 5

$\therefore y=3x+0 \rightarrow$ if c is not shown the value of c is 0

$\therefore$ The gradient of the line is **3**. $\rightarrow$ the gradient (m) is the coefficient of x.

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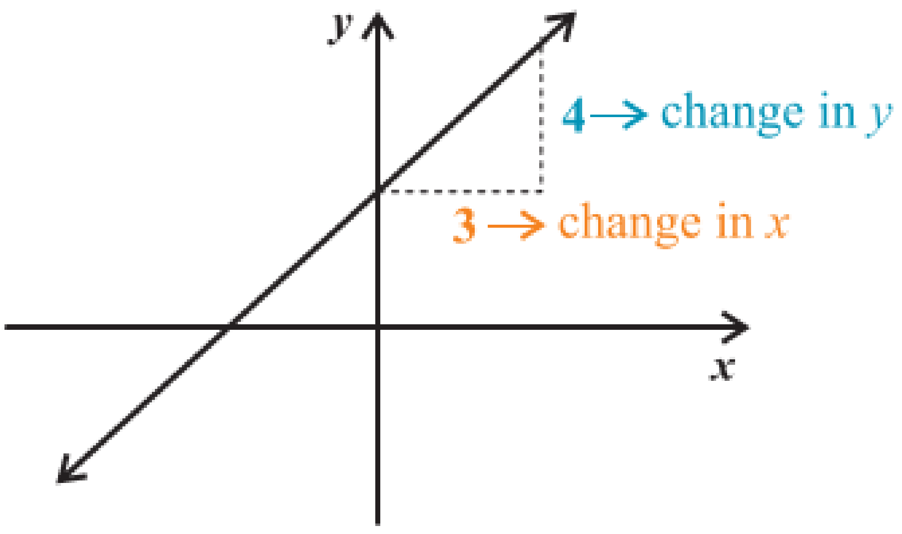
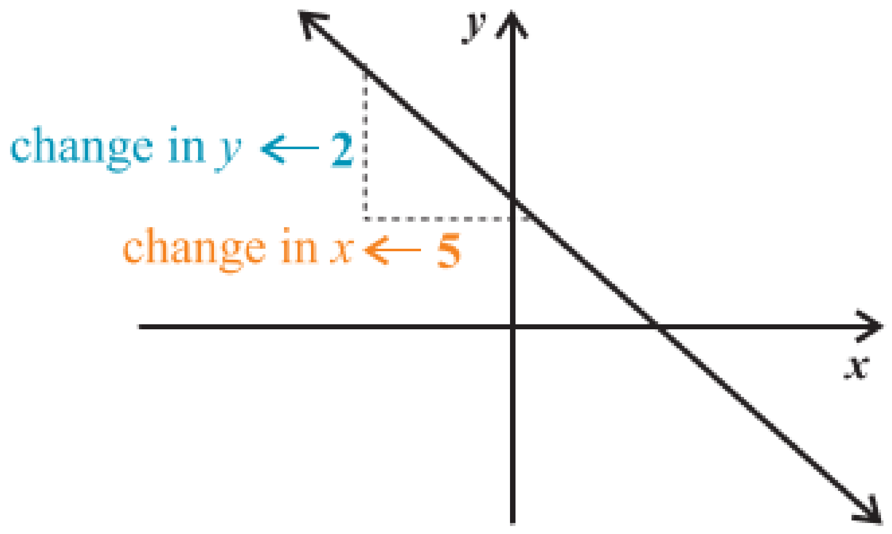
Example 8: **Determine the gradient of the straight line shown below:**



$$m = \frac{\text{change in } y}{\text{change in } x}$$

$$= \frac{4}{3}$$

Example 9: **Determine the gradient of the straight line shown below:**



It is important to note that the **gradient** of the straight line has a **negative gradient**. The numbers shown in the diagram above are the lengths of a line which is why they are not negative.

$$m = \frac{\text{change in } y}{\text{change in } x}$$

$$= -\frac{2}{5}$$

The gradient of a horizontal line is 0.
The gradient of a vertical line is undefined.

Complete Exercise 4 on pages 351 and 352.

E. DETERMINING THE EQUATION OF A STRAIGHT LINE

There are cases in which you will be expected to determine the equation of a linear function:

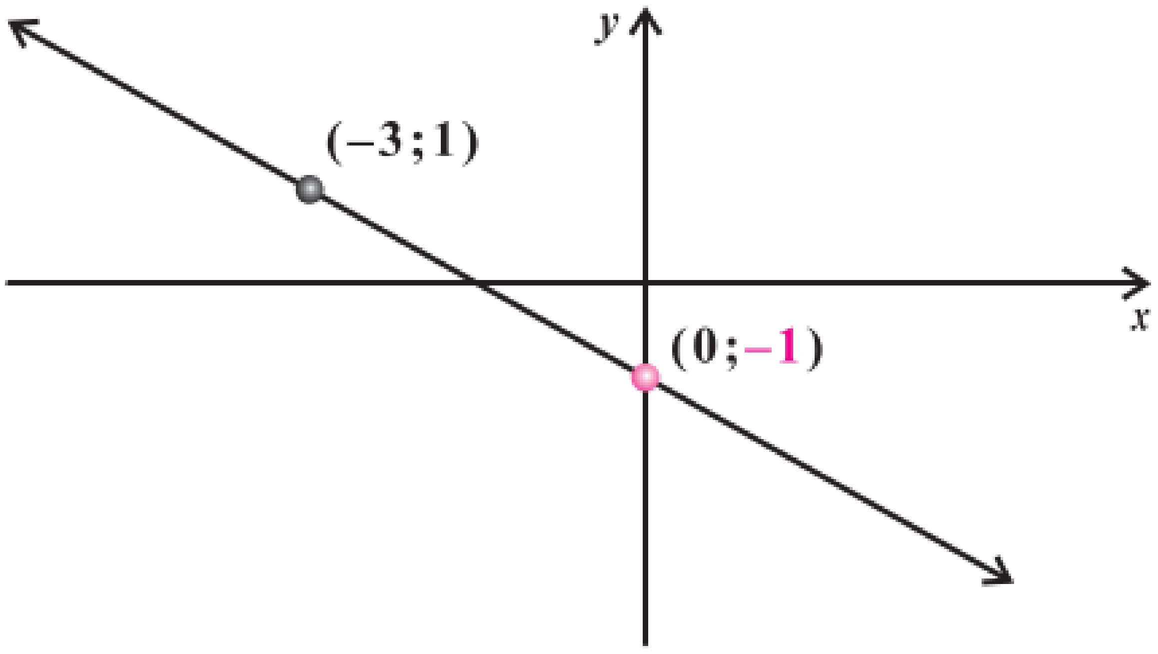
1. **You will be given the y-intercept and one other point.**
2. **You will be given the coordinates of two points on the line.**

CASE 1: GIVEN THE Y-INTERCEPT AND ONE OTHER POINT

In this case, substitute the ***y*-intercept** for c into the equation $y = mx + c$.

You then determine the value of m (the gradient) using the equation $m = \dfrac{y_2 - y_1}{x_2 - x_1}$.

Example 1: Determine the equation of the straight line shown below:



$$y = mx + c$$

$$\therefore y = mx - 1 \rightarrow -1 \text{ is the } y\text{-intercept}$$

You now have to calculate the gradient:

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-1 - 1}{0 - (-3)} \\ &= -\frac{2}{3} \end{aligned}$$

$$\therefore y = -\frac{2}{3}x - 1$$

Example 2: Determine the equation of the straight line passing through the points (0;5) and (–3;–1).

$$y = mx + c$$

$$\therefore y = mx + 5 \rightarrow 5 \text{ is the } y\text{-intercept as the } x\text{-value at this point is } 0$$

You now have to calculate the gradient:

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-1 - 5}{-3 - 0} \\ &= 2 \end{aligned}$$

$$\therefore y = 2x + 5$$

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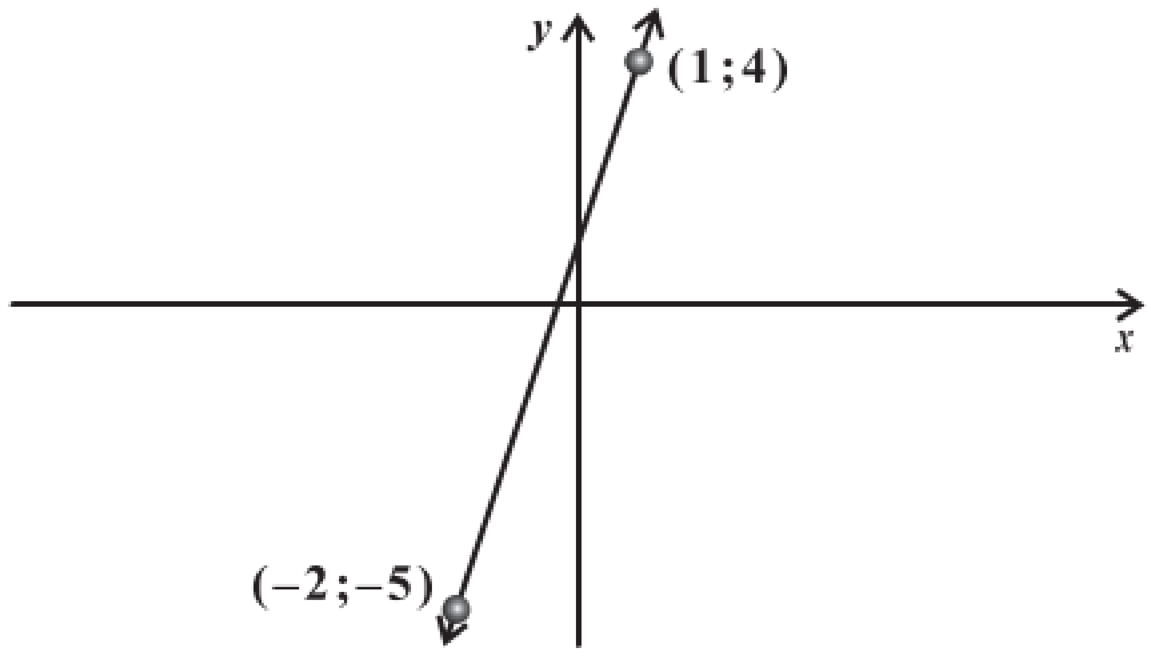
CASE 2: GIVEN ANY TWO POINTS

In this case, determine the value of m (the gradient) using the equation $m = \frac{y_2 - y_1}{x_2 - x_1}$.

You then substitute **one** of the given points into the equation $y = mx + c$ to solve for c.

Example 1: Determine the equation of the straight line shown below:



The gradient of the line is: $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4-(-5)}{1-(-2)} = \frac{4+5}{1+2} = 3$

$\therefore y = 3x + c$

Now substitute **either** $(1;4)$ or $(-2;-5)$ into the equation:

Substituting $(1;4)$

$\therefore 4 = 3(1) + c$

$\therefore 4 = 3 + c \rightarrow$ take the 3 to the LHS

$\therefore 1 = c$

$\therefore y = 3x + 1$

or

Substituting $(-2;-5)$

$\therefore -5 = 3(-2) + c$

$\therefore -5 = -6 + c \rightarrow$ take the -6 to the LHS

$\therefore 1 = c$

$\therefore y = 3x + 1$

You only have to substitute one point in order to solve for *c*.

Example 2: Determine the equation of the straight line passing through the points (8;8) and (12;16).

The gradient of the line is: $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{16-8}{12-8} = 2$

$\therefore y = 2x + c$

Now substitute **either** $(8;8)$ or $(12;16)$ into the equation:

Substituting $(8;8)$

$\therefore 8 = 2(8) + c$

$\therefore 8 = 16 + c \rightarrow$ take the 16 to the LHS

$\therefore -8 = c$

$\therefore y = 2x - 8$

or

Substituting $(12;16)$

$\therefore 16 = 2(12) + c$

$\therefore 16 = 24 + c \rightarrow$ take the 24 to the LHS

$\therefore -8 = c$

$\therefore y = 2x - 8$

Complete Exercise 5 on pages 352 and 353.

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F. EXTENSION

The topics covered in this section are not officially in the CAPS curriculum for Grade 9, but can be included if time permits.

PARALLEL LINES

Straight lines which are **parallel** have the **same gradient**.

Example 1: Determine the equation of the straight line which is parallel to the line $y = 2x + 1$ and passes through the point (5;15).

As the line is parallel to $y = 2x + 1$ the gradient of the line is **2**.

$\therefore y = 2x + c$

substitute the point $(5;15)$ to solve for c

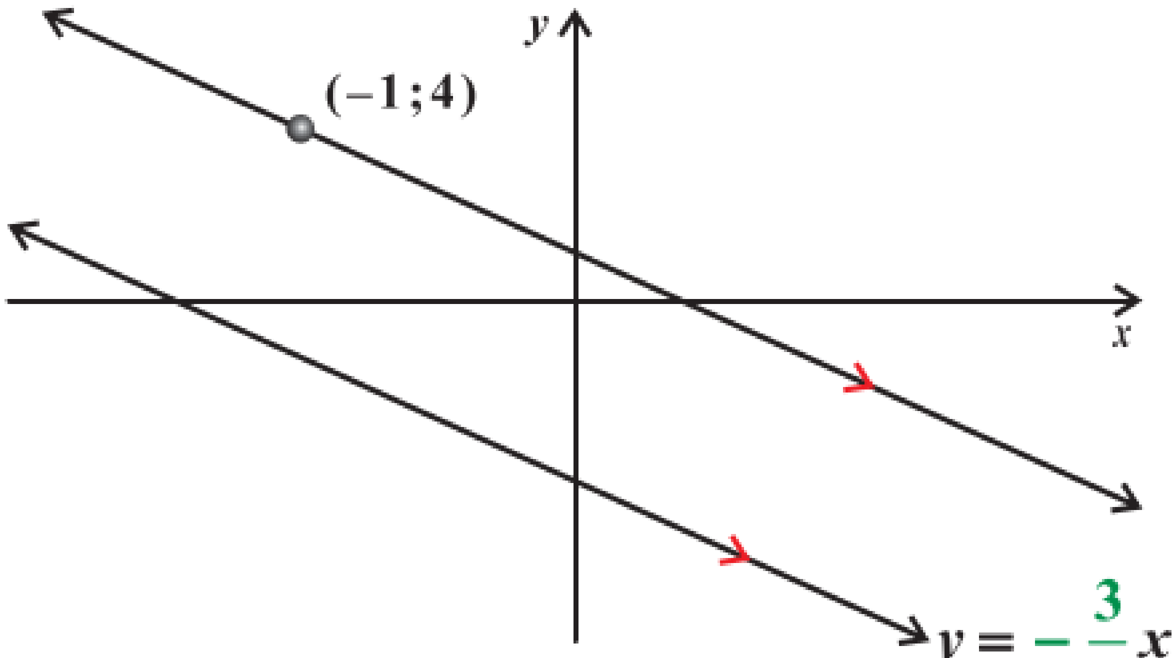
$\therefore 15 = 2(5) + c$

$\therefore 15 = 10 + c \rightarrow$ take the 10 to the LHS

$\therefore 5 = c$

$\therefore$ the equation of the line is $y = 2x + 5$

Example 2: The lines shown below are parallel to each other. Determine the equation of the line which passes through the point (–1;4).



$y = -\frac{3}{5}x - 2$

As the line is parallel to $y = -\frac{3}{5}x - 2$ the gradient of the parallel line is $-\frac{3}{5}$.

$\therefore y = -\frac{3}{5}x + c$

substitute the point $(-1;4)$

$\therefore 4 = -\frac{3}{5}(-1) + c$

$\therefore 4 = \frac{3}{5} + c \rightarrow$ take the $\frac{3}{5}$ to the LHS

$\therefore 4 - \frac{3}{5} = c$

$\therefore \frac{17}{5} = c$

$\therefore$ the equation of the line is $y = -\frac{3}{5}x + \frac{17}{5}$

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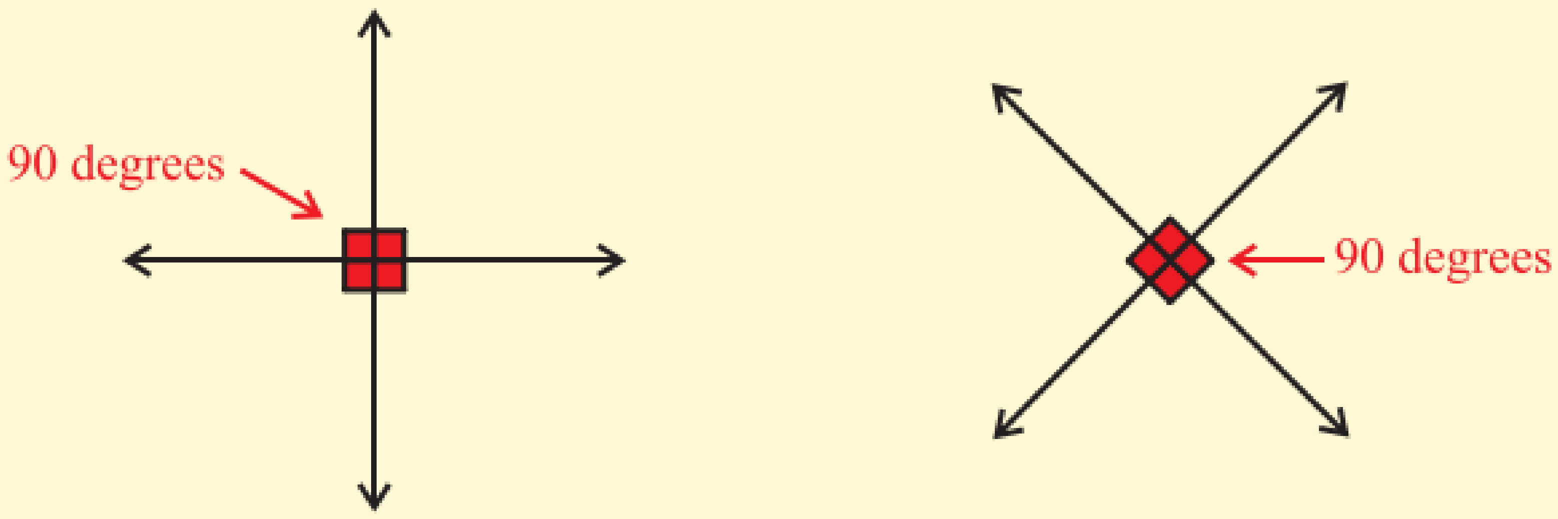
PERPENDICULAR LINES

The **gradients of perpendicular lines** are **negative reciprocals** of each other.

This means that if two lines are **perpendicular**, and the gradient of one line is $\frac{a}{b}$ the gradient of the other line is $-\frac{b}{a}$.

If two lines are **perpendicular**, they **intersect** each other **at 90º**. This is shown below:



Example 1: **Line AB is perpendicular to line CD. The gradient of line AB is $\frac{3}{2}$. What is the gradient of line CD?**

$m_{\text{AB}} = \frac{3}{2}$

$\therefore m_{\text{CD}} = -\frac{2}{3}$

The symbol for parallel is //.
The symbol for perpendicular is $\perp$.

Example 2: **Determine the equation of the straight line which is perpendicular to the line $y = \frac{4}{3}x + 3$ and passes through the point (8 ; 1).**

As the line is perpendicular to $y = \frac{4}{3}x + 3$, the gradient of the perpendicular line is $-\frac{3}{4}$.

$\therefore y = -\frac{3}{4}x + c$

substitute the point $(8;1)$

$\therefore 1 = -\frac{3}{4}(8) + c$

$\therefore 1 = -6 + c \rightarrow$ take the -6 to the LHS

$\therefore 7 = c$

$\therefore$ the equation of the line is $y = -\frac{3}{4}x + 7$

Complete Exercise 6 on page 353 and the Mixed Exercise on pages 353 and 354.

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TERM 2
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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

AI CAPS

Question 1 : Explained Answers By CAPS AI

ⓘ **CAPS AI** is the first reliable and trusted academic AI that you can ask questions as you go through your **textbooks, question papers, and notes,** it is programmed with the fundamental **CAPS** curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the **South African CAPS curriculum** and it can further your understanding about any subject topic in general.

Learn With CAPS AI

ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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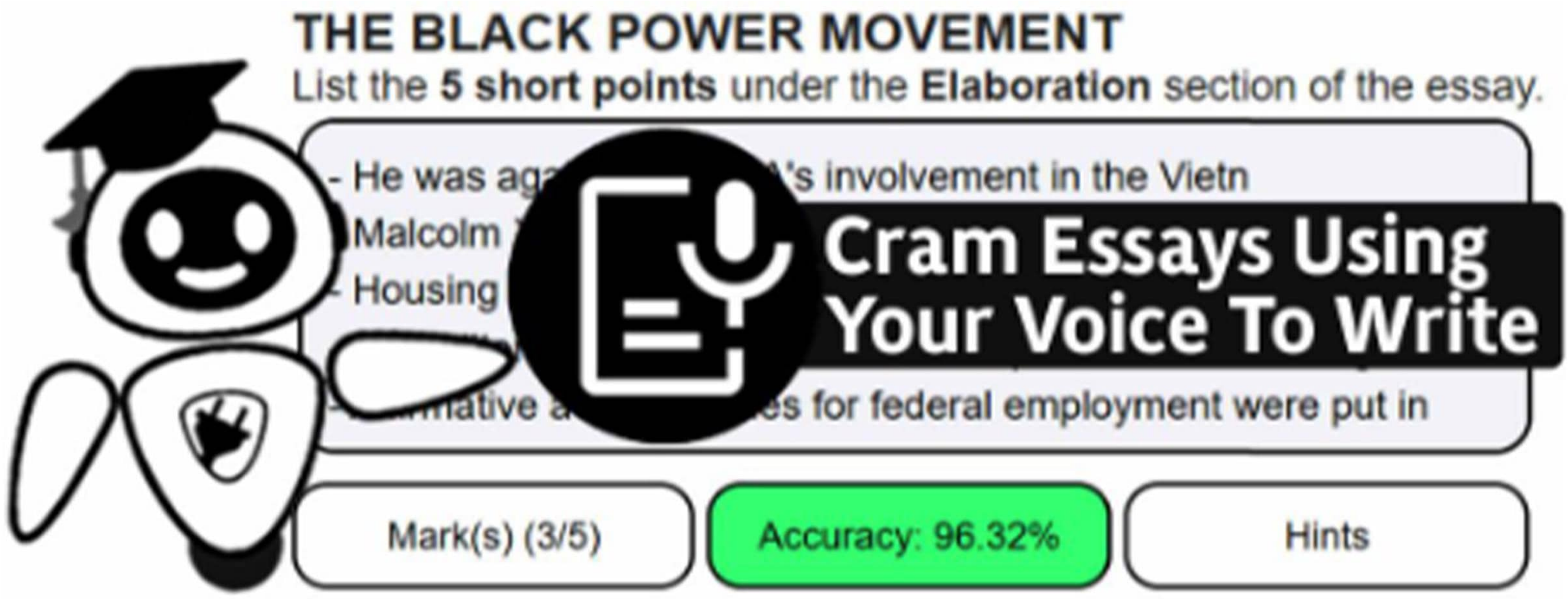

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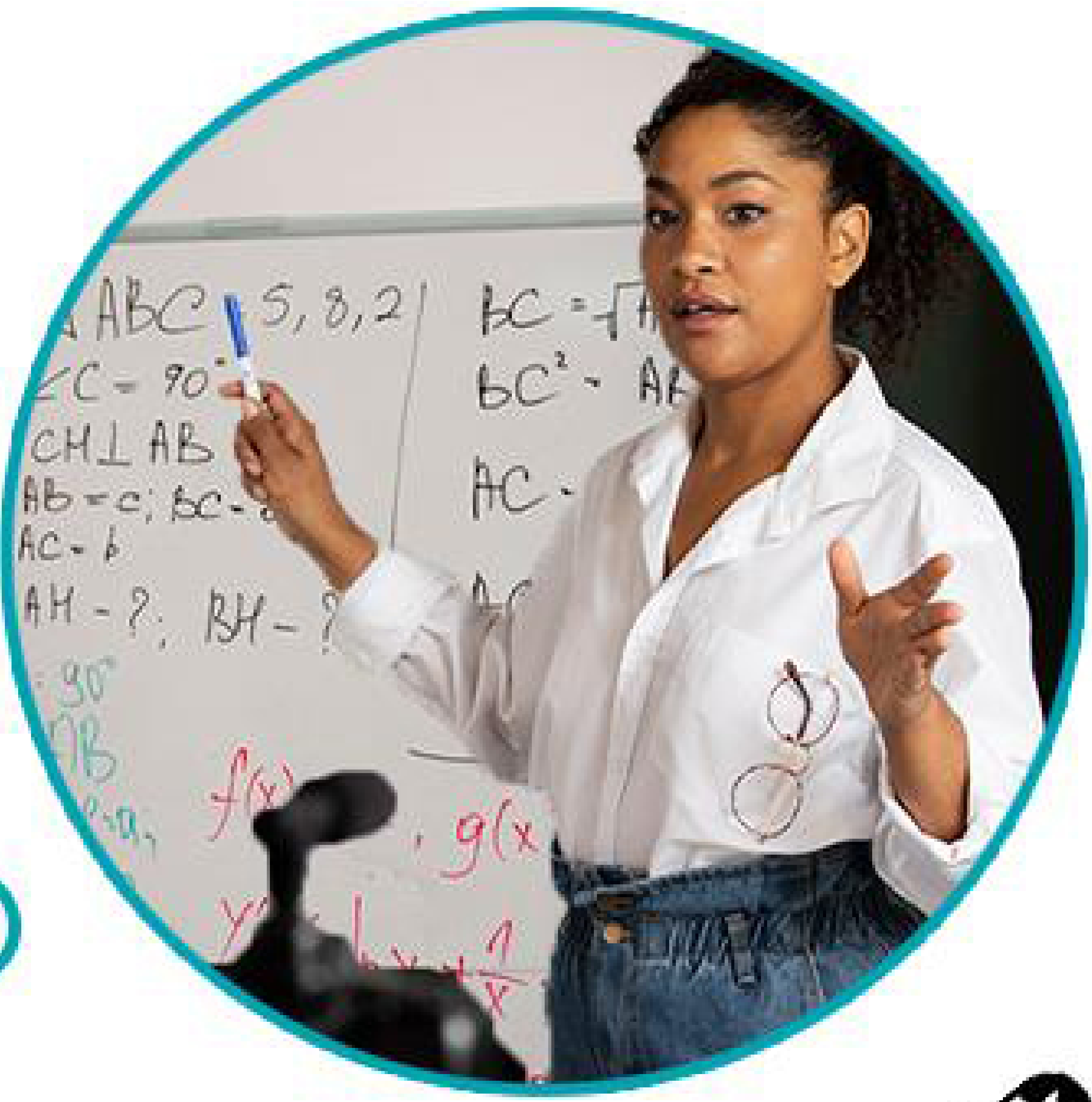

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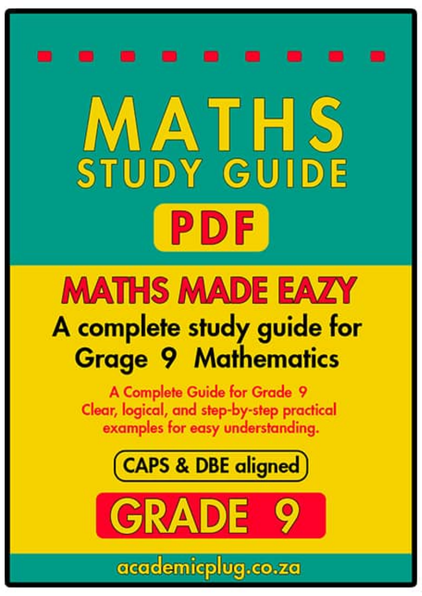

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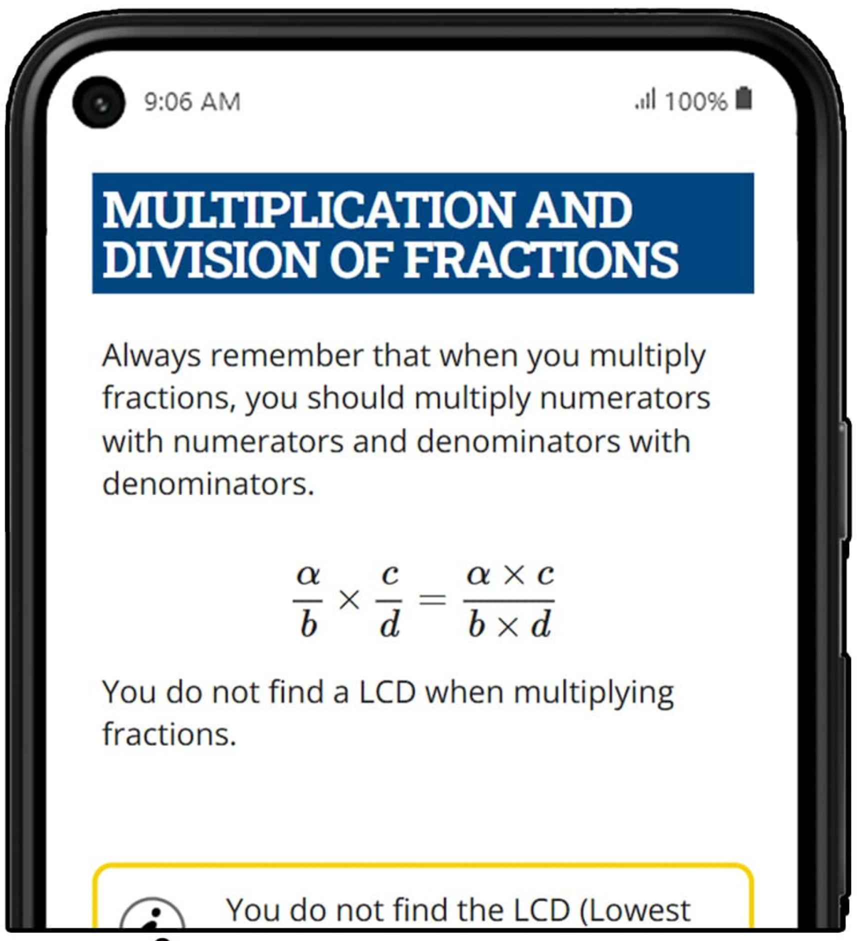

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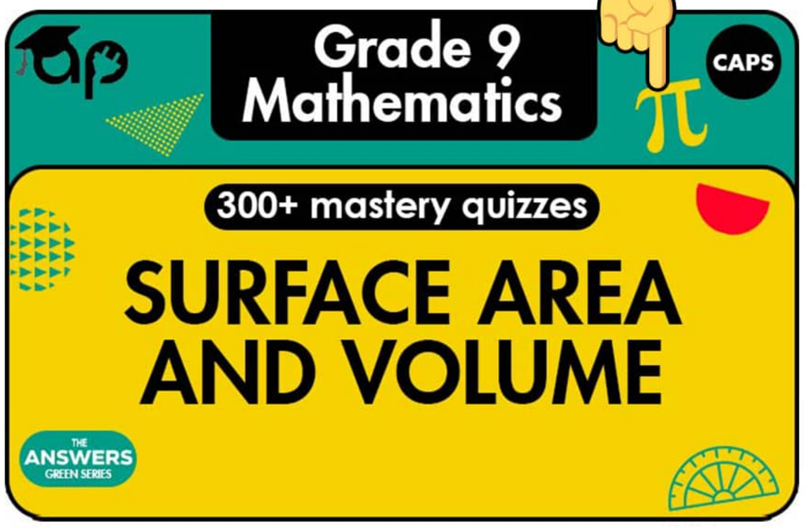

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CHAPTER 17
SURFACE AREA AND VOLUME

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
179	**A. Grade 8 Revision**	4.2	• Use appropriate formulae and conversions between SI units to solve problems and calculate the surface area, volume and capacity of cubes, rectangular prisms, triangular prisms and cylinders • Investigate how doubling any or all the dimensions of right prisms and cylinders affects the volume
179	• Surface Area of a Right Prism		
179	• Volume of a Right Prism		
180	• Surface Area of a Triangular Prism		
180	• Volume of a Triangular Prism		
181	• Summary of Grade 8 Formulas		
182	• Converting Between Different Units		
185	**B. The Cylinder**		
185	• Surface Area of a Cylinder		
185	• Volume of a Cylinder		
188	**C. The Effect on Volume of Doubling Dimensions**		
190	**D. Summary of Formulas**		

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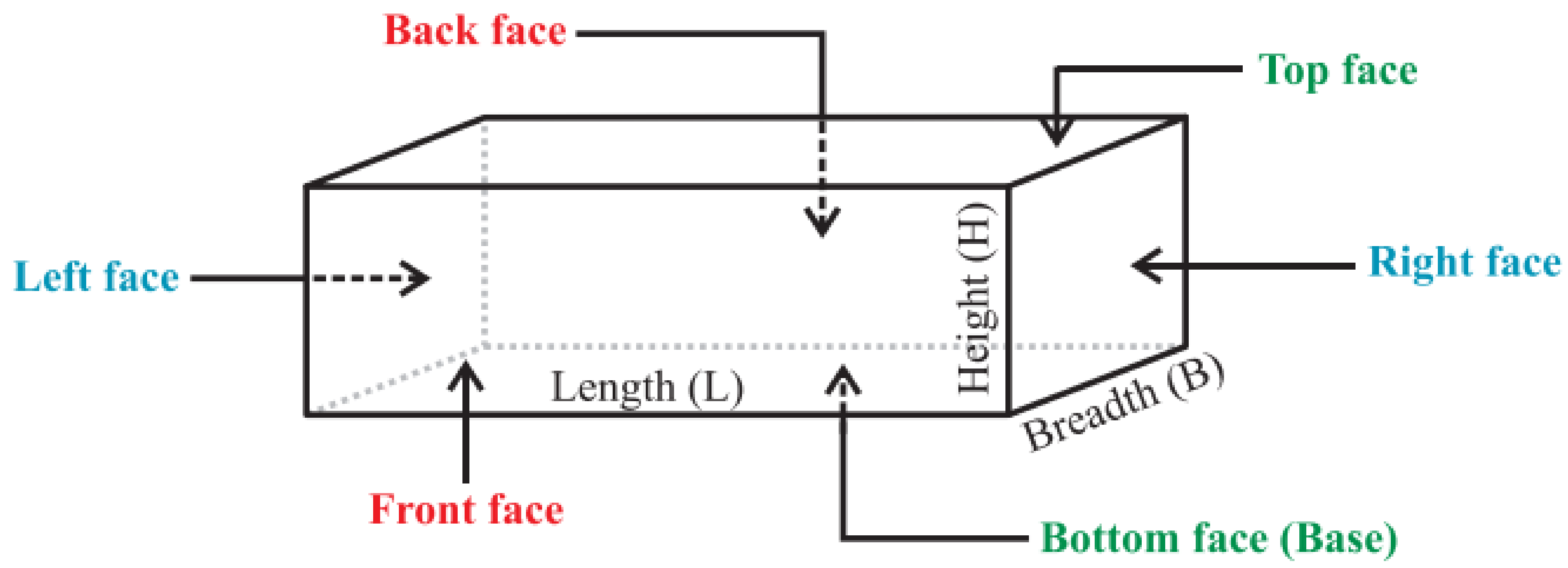
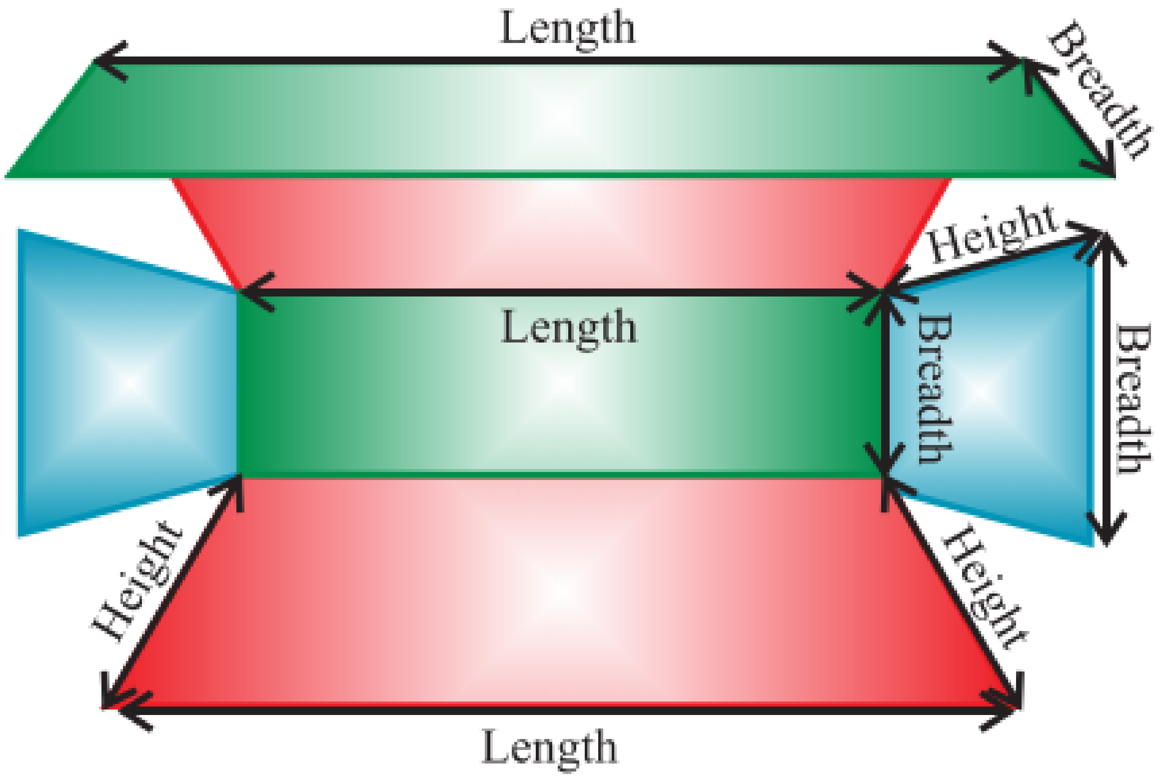
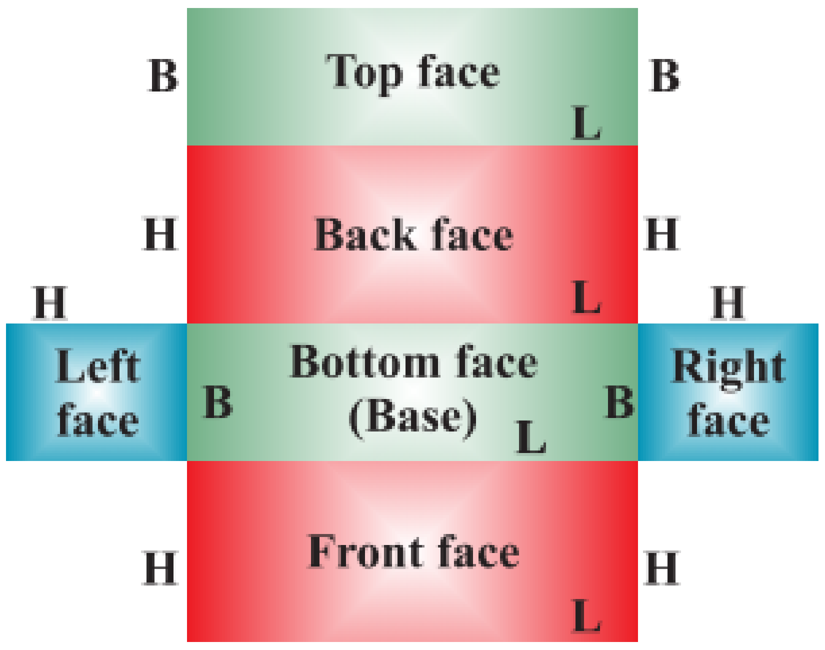
SURFACE AREA OF A RIGHT PRISM

The **surface area** of a right prism is the **sum of the areas of each individual face** that makes up the **surface of the prism**.







$$SA = (A_{\text{Left Face}} + A_{\text{Right Face}}) + (A_{\text{Front Face}} + A_{\text{Back Face}}) + (A_{\text{Bottom Face}} + A_{\text{Top Face}})$$

$$= (BH + BH) + (LH + LH) + (LB + LB)$$

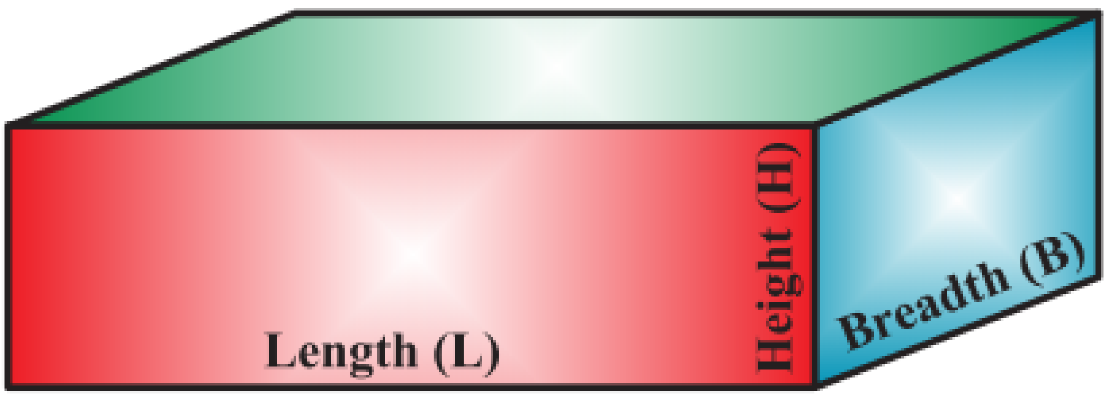
$$= 2BH + 2LH + 2LB$$

Surface Area of a Right Prism:

$$SA = 2BH + 2LH + 2LB$$

VOLUME OF A RIGHT PRISM

The **volume** of any three-dimensional shape is the **area of the base shape multiplied by** the **height** it is extended by.



Volume of a Right Prism:

$$V = L \times B \times H$$

The volume of a prism is the amount of space the prism occupies.
The capacity of a prism is the amount that a prism can hold.
Both volume and capacity are measured in cubic units.

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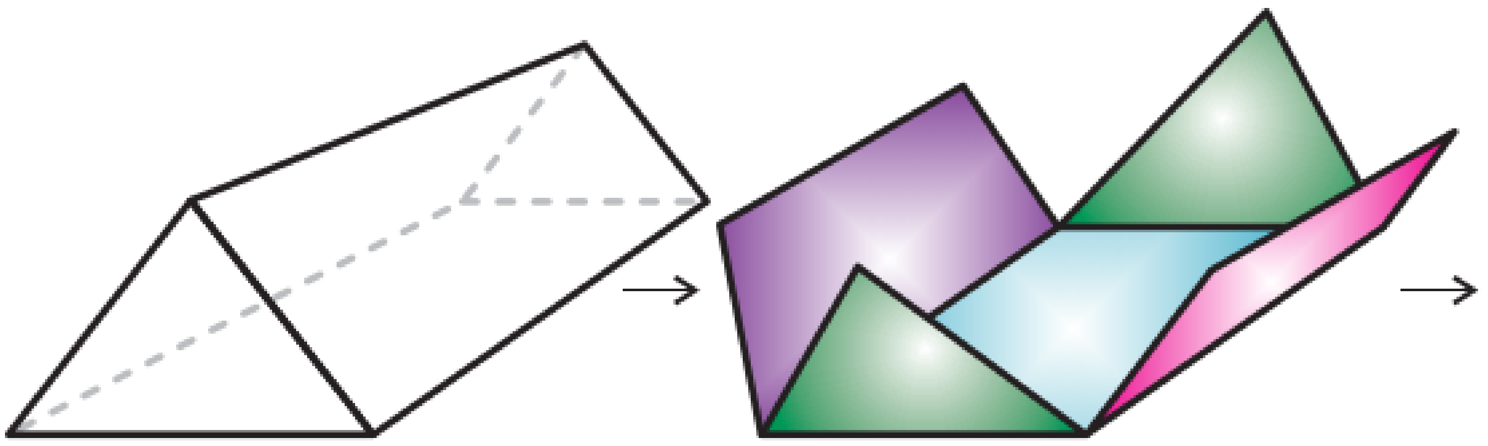
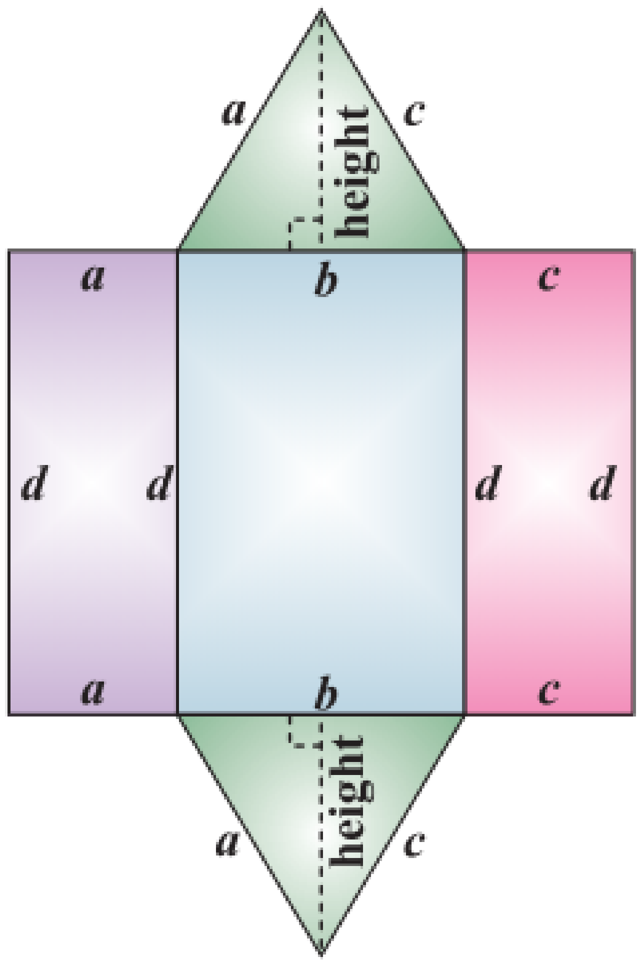
SURFACE AREA OF A TRIANGULAR PRISM

A **triangular prism** is a **prism** that **has triangles as bases**.
If the prism has a **right-angled triangle as a base**, the prism is known as a **right triangular prism.**
You will often have to use the Theorem of Pythagoras when dealing with triangular prisms.





$$SA = A_{Purple\square} + A_{Pink\square} + A_{blue\square} + 2\times A_{green\triangle}$$
$$= (ad) + (cd) + (bd) + 2\times\frac{1}{2}(b\times \text{height})$$
$$= ad + cd + bd + b\times \text{height}$$

Surface Area of a Triangular Prism:

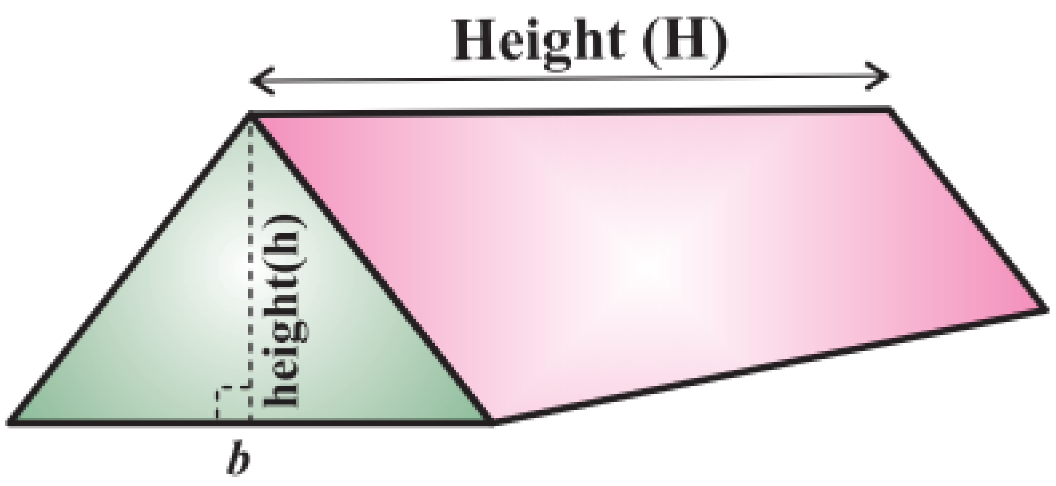
$$SA = ad + cd + bd + 2\times\frac{1}{2}(b\times \text{height})$$

If the triangle base is isosceles, *a* and *c* will be equal and the area of the purple and pink rectangles will be the same.

If the triangle base is equilateral, *a*, *b* and *c* will be equal and the area of all the rectangles will be the same.

VOLUME OF A TRIANGULAR PRISM

There are two different heights in a triangular prism. The first is the **perpendicular height (h) of the triangular base**. This height is **used to calculate** the **area of the base**. **Volume** is the **area of the base triangle multiplied** by the **height the prism (H)** is extended by.



Volume of a Triangular Prism:

$$V = \frac{1}{2}(b\times h)\times H$$

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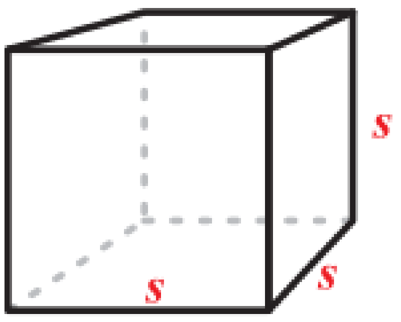
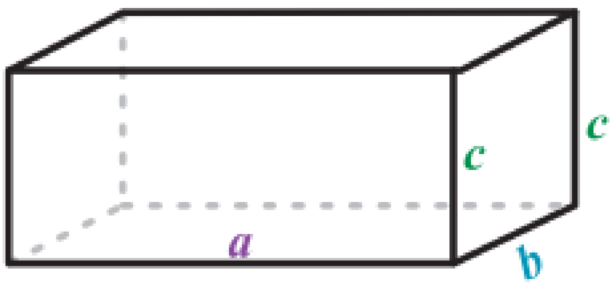
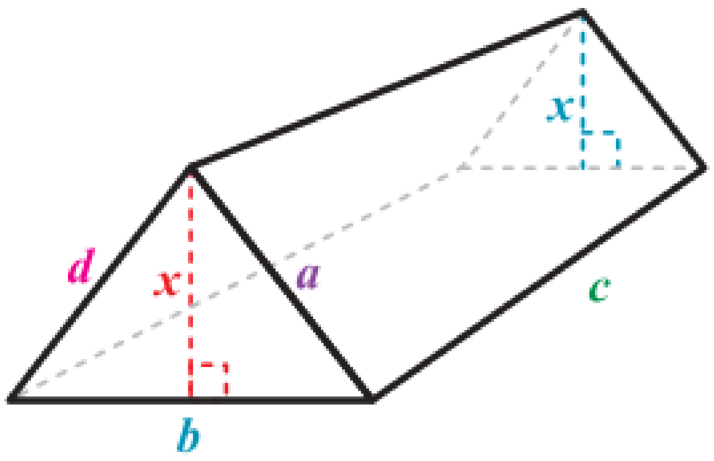
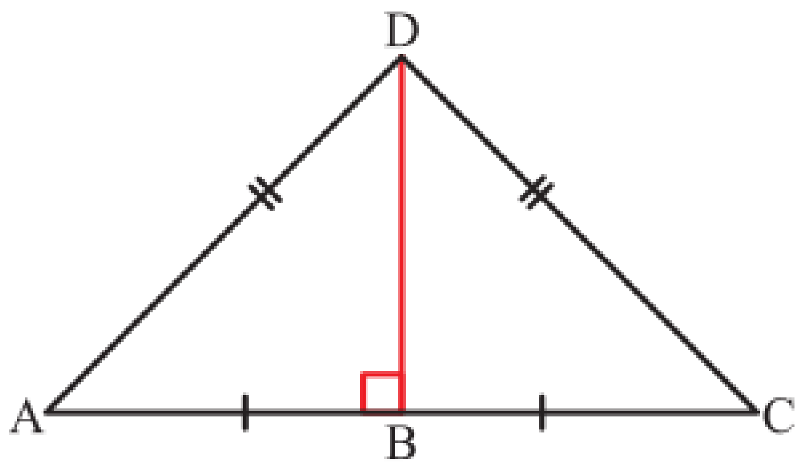
SUMMARY OF GRADE 8 FORMULAS

Shape	Surface Area	Volume
Cube  **All sides are equal. This means that the area of all six faces are the same.**	$SA = 6(s)^2$	$V = (s)^3$
Rectangular prism (cuboid)  **There are a total of 6 faces. When calculating surface area add the area of each face together.**	$SA = 2(ab) + 2(ac) + 2(bc)$	$V = a \times b \times c$
Triangular prism  **There are 3 rectangular faces and 2 triangular faces. When calculating surface area add the area of each face together.**	$SA = ac + dc + bc + 2 \times \frac{1}{2}(b \times x)$ $= ac + dc + bc + bx$	$V = \frac{1}{2}(b \times x) \times c$

In an equilateral or isosceles triangle, the perpendicular height divides the base into two equal parts. In other words, in the diagram below, AB = BC.



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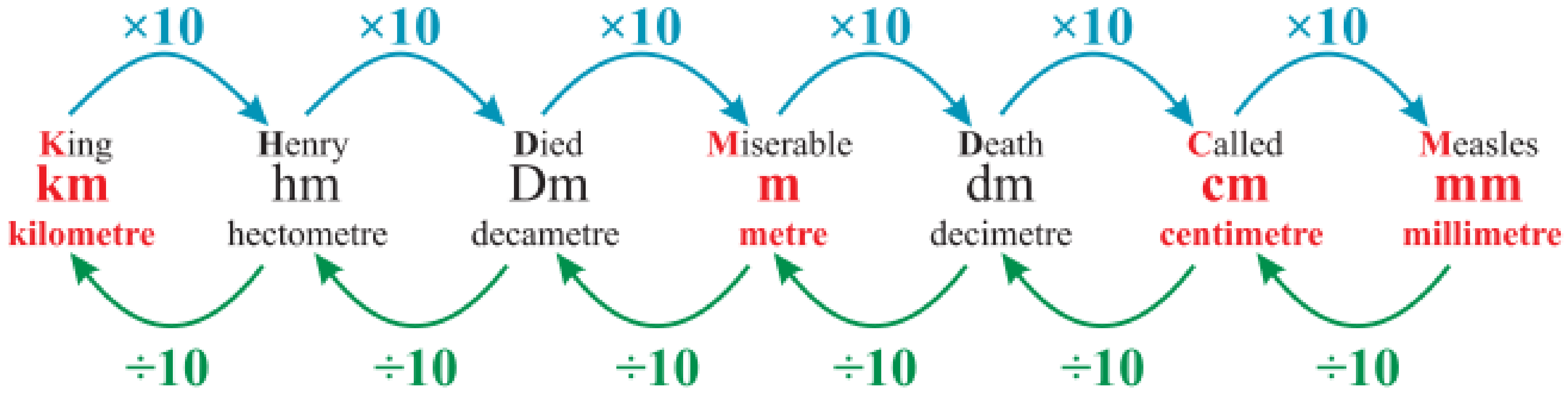
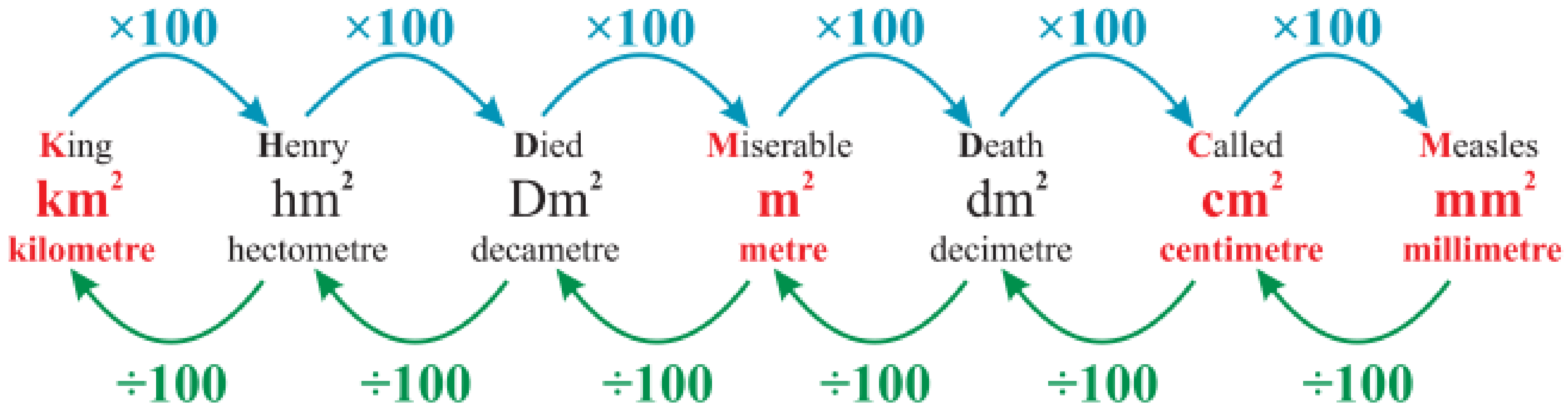
CONVERTING BETWEEN DIFFERENT UNITS

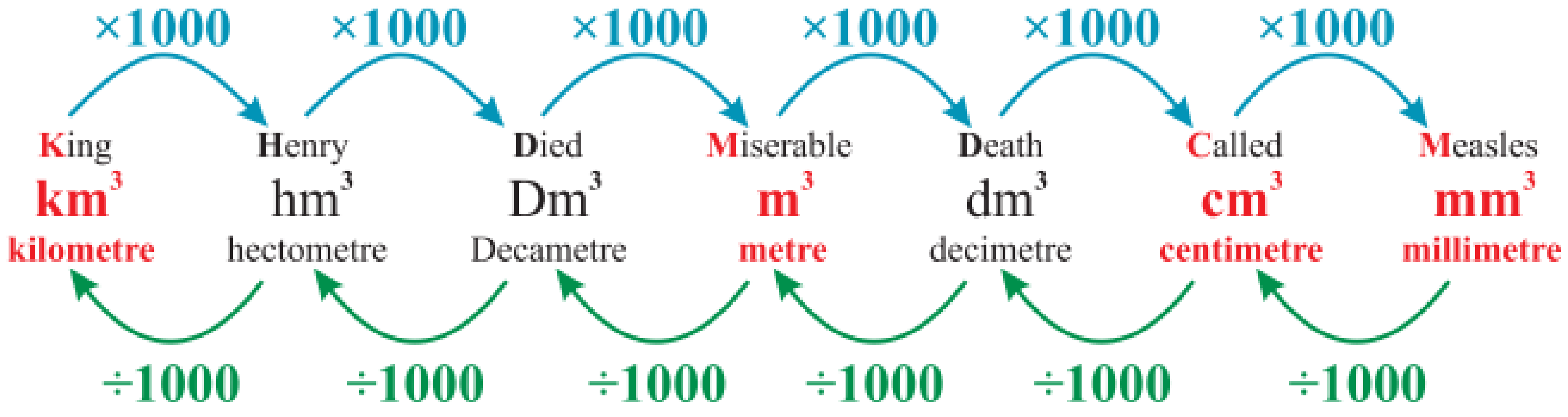
To convert between units, when **moving** to the **right** you **multiply by 10** and when **moving left** you **divide by 10**.



If you are dealing with **area**, when moving **right** on the diagram you **multiply by 100** and when moving **left** you **divide by 100**.



If you are dealing with **volume**, when moving **right** on the diagram you **multiply** by **1000** and when moving **left** you **divide** by **1000**.



Capacity and volume are often measured according to the amount of water an object can hold or displace.

An object with a volume of 1cm^3 will displace 1m*l* (millilitre) of water and will hold a capacity of 1m*l*.

An object with a volume of 1m^3 will displace 1000*l* (litres) of water and will hold a capacity of 1000*l*.

$$1\text{m}l = 1\text{cm}^3$$

$$1l \text{ (litre)} = 1000\text{m}l = 1000\text{cm}^3 = 1\text{dm}^3 \text{ (decimetre)}$$

$$1000l = 1\text{k}l \text{ (kilolitre)} = 1\text{m}^3$$

It is important to note that there is 1000m*l* in 1 litre.

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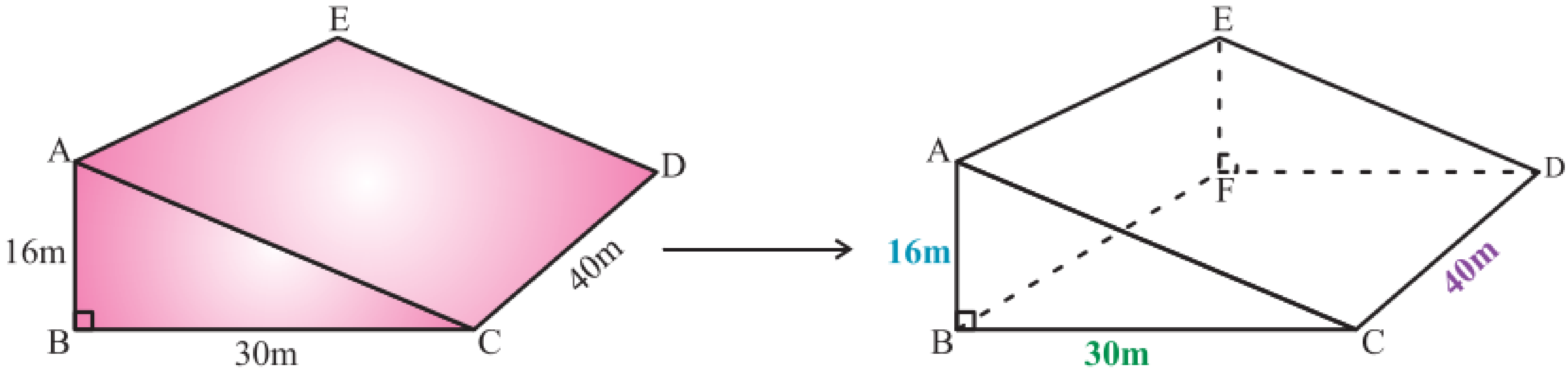
Example 1: **The right triangular prism below has dimensions as shown on the diagram:**



a) Determine the volume of the prism.
b) Determine the surface area of the prism.

a) $V = A_{\triangle ABC} \times CD$ → area of base shape × height

$= \frac{1}{2}(16)(30) \times 40$

$= 9\,600\,\text{m}^3$

b)

Before you can find surface area, you need to calculate the length of AC.

$AC^2 = AB^2 + BC^2$ → pythag

$= (16)^2 + (30)^2$

$= 1156$

$\therefore AC = 34\,\text{m}$ → $AC^2 = 1156, \therefore AC = \sqrt{1156} = 34$

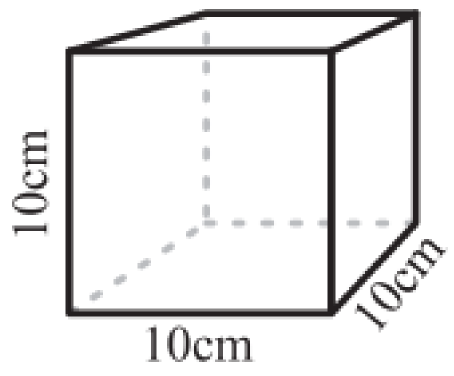
$SA = 2A_{\triangle ABC} + A_{ACDE} + A_{ABFE} + A_{BCDF}$

$= 2\left(\frac{1}{2}\right)(16)(30) + (34)(40) + (16)(40) + (30)(40)$

$= 480 + 1360 + 640 + 1200$

$= 3\,680\,\text{m}^2$

Example 2: **The cube alongside has the dimensions shown on the diagram. Determine the surface area and volume of the cube.**



$SA = 6 \times (\text{the area of a single face})$ → the area of a square is s^2

$= 6(10)^2$ → each face is a square

$= 600\,\text{cm}^2$

$V = s^3$ → the volume of a square cube is s^3

$= 10^3$

$= 1000\,\text{cm}^3$

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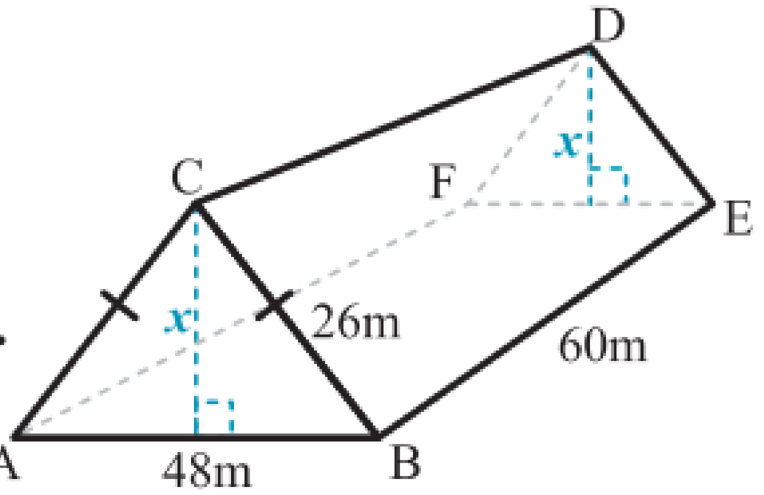
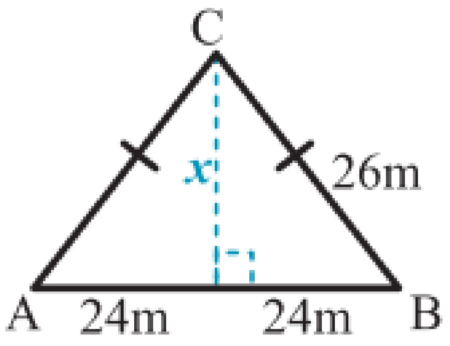
Example 3: **The triangular prism has dimensions as shown on the diagram alongside.**
a) Determine the area of triangle ABC.
b) Determine the volume of the prism.
c) Determine the surface area of the prism.



a) As ABC is isosceles, the perpendicular height (x) divides base AB in half.

$$x^2 = 26^2 - 24^2 \rightarrow \text{pythag}$$
$$= 100$$
$$\therefore x = 10\,\text{m}$$



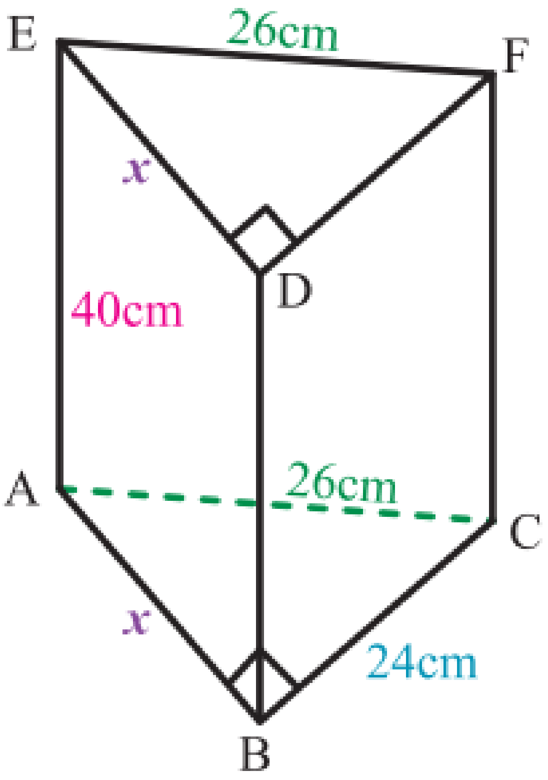
$$A = \frac{1}{2}(AB)(x)$$
$$= \frac{1}{2}(48)(10)$$
$$= 240\,\text{m}^2$$

b) $$V = A_{\triangle ABC} \times BE \rightarrow \text{area of base shape} \times \text{height}$$
$$= 240 \times 60$$
$$= 14\,400\,\text{m}^3$$

c) As triangle ABC is an isosceles triangle, the two rectangles which make up the side of the prism (CBED and AFDC) are identical.

$$SA = 2(CB \times BE) + (AB \times BE) + 2A_{\triangle ABC} \rightarrow \text{CBED is the same as rectangle AFDC}$$
$$= 2(26 \times 60) + (48 \times 60) + 2(240)$$
$$= 6\,480\,\text{m}^2$$

Example 4: **The right triangular prism has dimensions as shown on the diagram alongside.**
a) Determine the value of x.
b) Determine the surface area of the prism.
c) Determine the volume of the prism.



a) $$x^2 = 26^2 - 24^2 \rightarrow \text{pythag, } DF = BC = 24$$
$$= 100 \rightarrow \text{pythag}$$
$$\therefore x = 10\,\text{cm}$$

b) $$SA = (AB \times AE) + (BC \times FC) + (AC \times AE) + 2\left(\frac{1}{2} \times AB \times BC\right)$$
$$= 10(40) + 24(40) + 26(40) + 2\left(\frac{1}{2} \times 10 \times 24\right)$$
$$= 2\,640\,\text{cm}^2$$

c) $$V = A_{\triangle ABC} \times AE \rightarrow \text{area of base shape} \times \text{height}$$
$$= \frac{1}{2}(10)(24) \times 40 \rightarrow \frac{1}{2}(AB)(BC) \times AE$$
$$= 4\,800\,\text{cm}^3$$

Complete Exercise 1 on page 362.

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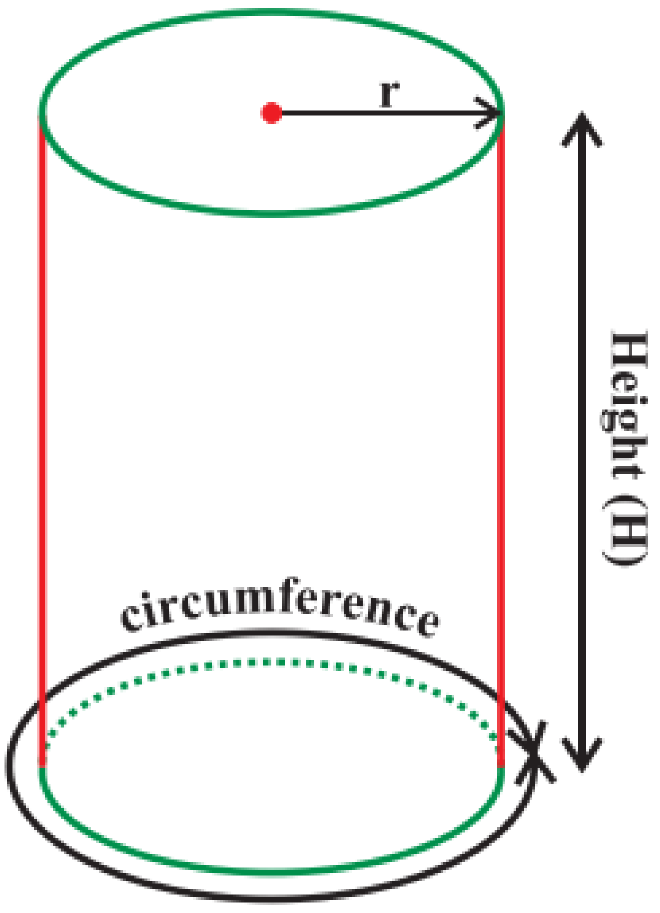
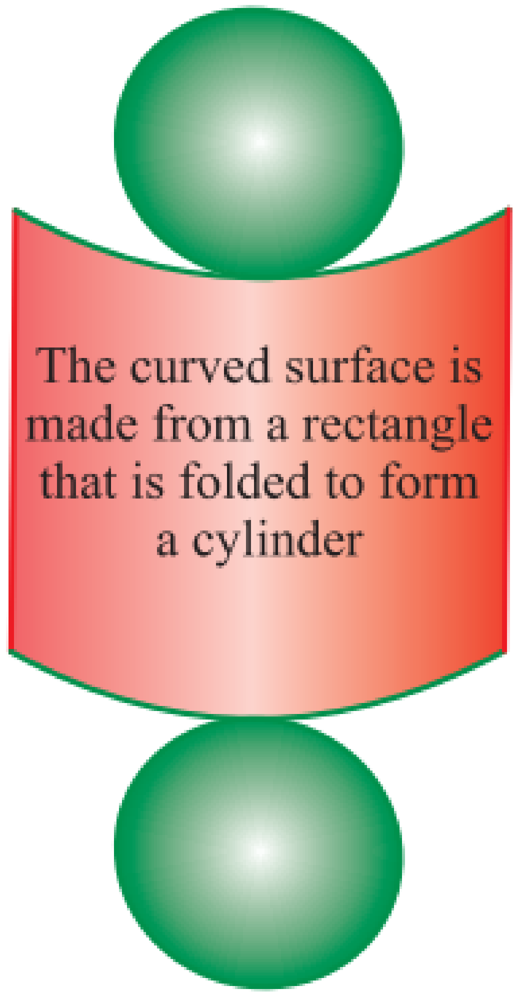
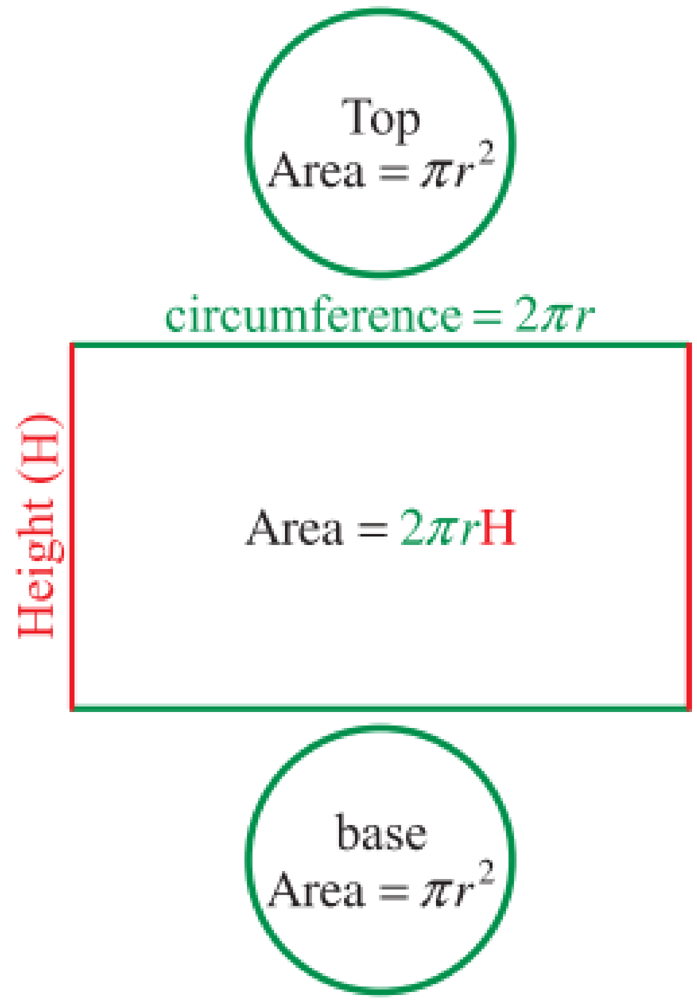
B. THE CYLINDER

SURFACE AREA OF A CYLINDER

A cylinder is made up of two circles and a rectangle. The area of the rectangle is the circumference of the circle multiplied by the height of the cylinder.
Be careful to take note whether the cylinder is open or closed.
If the cylinder is open the formula for the surface area must be adjusted.







$$SA = A_{rectangle} + A_{base} + A_{top}$$
$$= 2\pi rH + \pi r^2 + \pi r^2$$
$$= 2\pi rH + 2\pi r^2$$

Surface Area of a Cylinder:

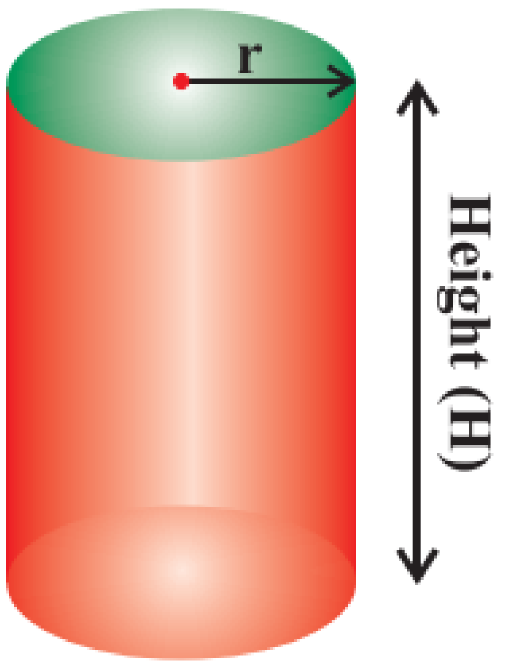
$SA = 2\pi rH + 2\pi r^2$ → **closed cylinder**

$SA = 2\pi rH + \pi r^2$ → **cylinder open on one end**

$SA = 2\pi rH$ → **cylinder open on both ends**

VOLUME OF A CYLINDER

As with most shapes, the **volume of a cylinder** is the **area of its base multiplied by the height it is extended by**. In the case of a **cylinder**, the **base is a circle**.



Volume of a Cylinder:

$$V = \pi r^2 \times H$$

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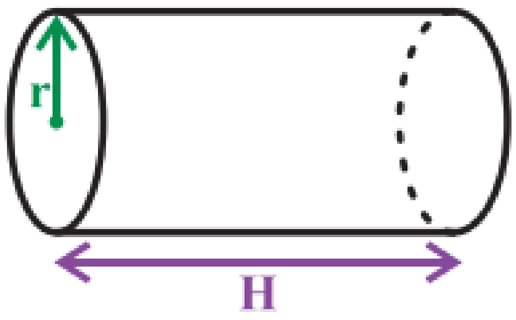
Example 1: **The cylinder shown alongside has a radius of 100cm and height of 4m. Determine:**



a) The surface area (in m^2) of the cylinder if it is closed on both ends

b) The surface area (in m^2) of the cylinder if it is closed on one end.

c) The surface area of the cylinder (in m^2) if it is open on both ends.

d) The volume the cylinder can hold. Give your answer in m^3.

When dealing with surface area and volume, all dimensions must be in the same units.
In this example, you were told to give answers in m^2 and m^3. Therefore, you must convert 100cm into m.
To convert from centimetres to metres, divide by 100.

$$100\,\text{cm} = \frac{100}{100}\text{m} \rightarrow \text{divide by 100 to convert cm to m}$$
$$= 1\text{m}$$

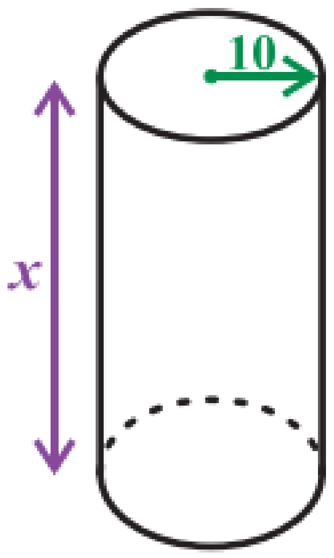
a) $$\text{SA} = 2\pi r\text{H} + 2\pi r^2 \rightarrow \text{the cylinder is closed on both ends}$$
$$= 2\pi(1)(4) + 2\pi(1)^2$$
$$= 10\pi$$
$$= 31{,}42\,\text{m}^2$$

b) $$\text{SA} = 2\pi r\text{H} + 1\pi r^2 \rightarrow \text{the cylinder is closed at 1 end}$$
$$= 2\pi(1)(4) + \pi(1)^2$$
$$= 9\pi$$
$$= 28{,}27\,\text{m}^2$$

c) $$\text{SA} = 2\pi r\text{H} \rightarrow \text{the cylinder is open at both ends so you don't add the area of the circles}$$
$$= 2\pi(1)(4)$$
$$= 8\pi$$
$$= 25{,}13\,\text{m}^2$$

d) $$\text{V} = \pi r^2\text{H} \rightarrow \text{area of base shape} \times \text{height}$$
$$= \pi(1)^2(4) \rightarrow \text{area of base shape} \times \text{height}$$
$$= 4\pi$$
$$= 12{,}57\,\text{m}^3$$

Example 2: **The cylinder shown alongside has a radius of 10m, a height of x metres and a volume of $785{,}4\text{m}^3$. Determine the value of x.**



$$\text{V} = \pi r^2\text{H}$$
$$\therefore 785{,}4 = (\pi)(10)^2(x)$$
$$\therefore 785{,}4 = 100\pi x \rightarrow \text{divide both sides by } 100\pi$$
$$\therefore \frac{785{,}4}{100\pi} = x$$
$$\therefore x = 2{,}5\,\text{m}$$

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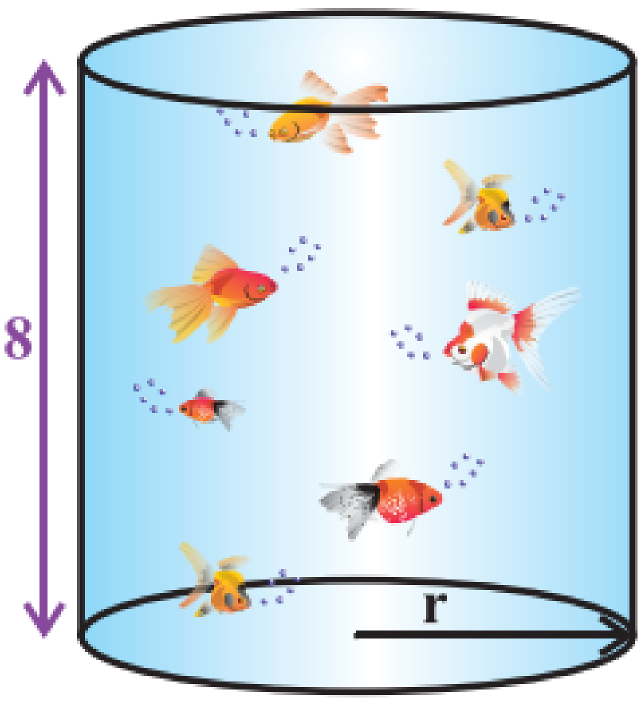
Example 3: A local hotel is constructing the cylindrical fish tank shown alongside to be placed in the hotel lobby. The fish tank is planned to stretch from the floor to the ceiling. The lobby's ceiling is 8 metres high and the tank can hold 125, 66 kilolitres of water. What is the radius of the fish tank?



Recap:
$1000l = 1kl$ (kilolitre) $= 1m^3$

$V = \pi r^2 H$

$\therefore 125{,}66 = (\pi)(r)^2(8)$

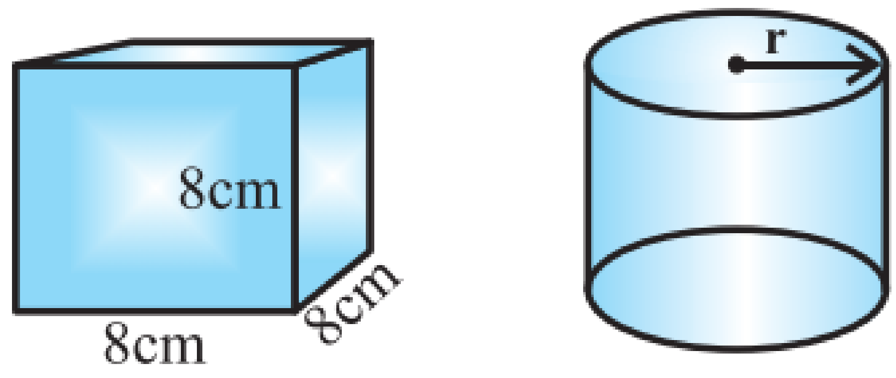
$\therefore 125{,}66 = 8\pi r^2 \rightarrow$ divide both sides by 8π

$\therefore \dfrac{125{,}66}{8\pi} = r^2 \rightarrow$ square root both sides

$\therefore \sqrt{\dfrac{125{,}66}{8\pi}} = r$

$\therefore r = 2{,}24\,\text{m}$

Example 4: A glass company currently manufactures a square drinking glass with a length of 8cm. They would like to change their design to a cylindrical glass of the same height. If the cylindrical glass is to hold the same volume of water as the square glass, what must the radius of the glass be?



$V_{\text{square glass}} = s^3$

$= 8^3$

$= 512\,\text{cm}^3$

$V_{\text{cyl glass}} = 512\,\text{cm}^3$

$\therefore 512 = (\pi)(r)^2(8)$

$\therefore 512 = 8\pi r^2 \rightarrow$ divide both sides by 8π

$\therefore \dfrac{512}{8\pi} = r^2 \rightarrow$ square root both sides

$\therefore \sqrt{\dfrac{512}{8\pi}} = r$

$\therefore r = 4{,}51\,\text{cm}$

Complete Exercise 2 on page 363.

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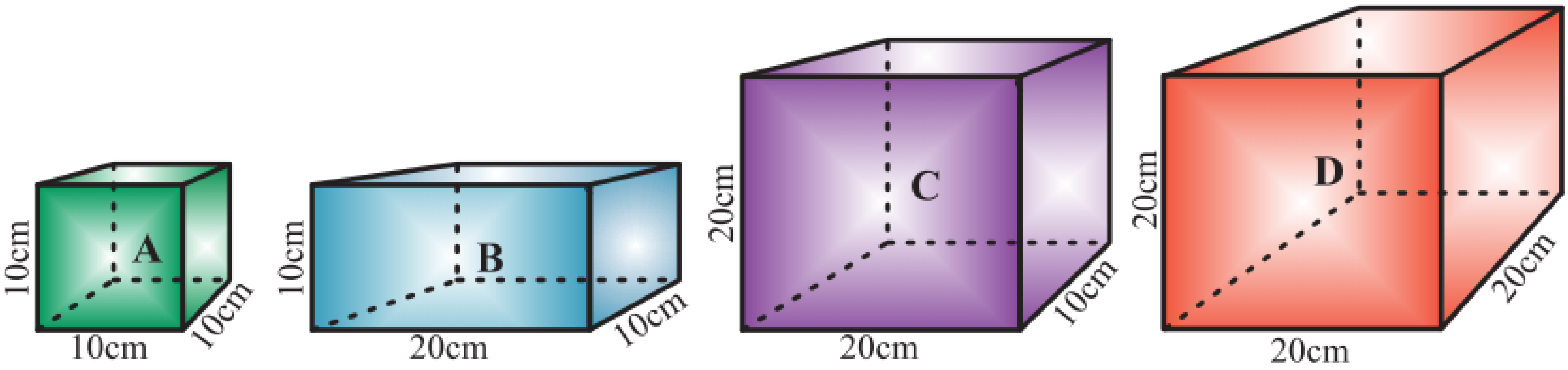
C. THE EFFECT ON VOLUME OF DOUBLING DIMENSIONS

Illustrative Example 1: **The rectangular prisms drawn below have dimensions as shown on the diagram.**



	Length	Breadth	Height	Volume
Cube A	10	10	10	$V = (10)(10)(10)$ $= \mathbf{1000\,cm^3}$
Cube B	10	20	10	$V = (10)(20)(10)$ $= \mathbf{2000\,cm^3}$
Cube C	10	20	20	$V = (10)(20)(20)$ $= \mathbf{4000\,cm^3}$
Cube D	20	20	20	$V = (20)(20)(20)$ $= \mathbf{8000\,cm^3}$

From the above table, it can be seen that for a rectangular prism:

- **Doubling the dimensions of one side increases the volume by a factor of 2^1. In other words, the volume is multiplied by 2.**
- **Doubling the dimensions of two sides increases the volume by a factor of 2^2 (4).** **In other words, the volume is multiplied by 4.**
- **Doubling the dimensions of three sides increases the volume by a factor of 2^3 (8).** **In other words, the volume is multiplied by 8.**

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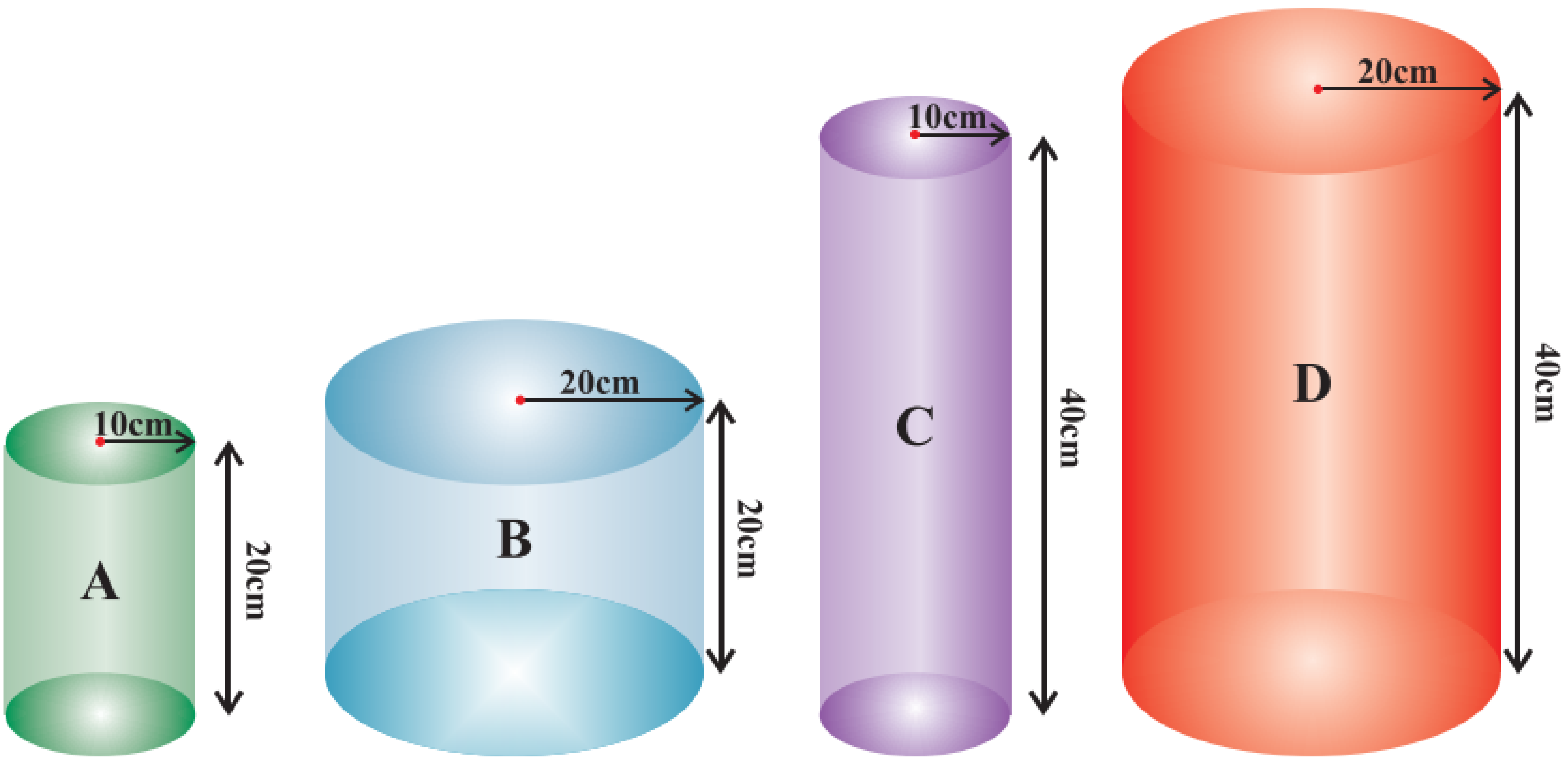
Illustrative Example 2: **Four cylinders are drawn below.**
The radius of cylinder B is double the radius of A.
The height of cylinder C is double the height of A.
All the dimensions of cylinder D are double those of A.



	Radius	Height	Volume
Cylinder A	10	20	$V = \pi r^2 H$ $= \pi(10)^2(20)$ $= \mathbf{2\,000\pi\ cm^3}$
Cylinder B	20	20	$V = \pi r^2 H$ $= \pi(20)^2(20)$ $= \mathbf{8\,000\pi\ cm^3}$
Cylinder C	10	40	$V = \pi r^2 H$ $= \pi(10)^2(40)$ $= \mathbf{4\,000\pi\ cm^3}$
Cylinder D	20	40	$V = \pi r^2 H$ $= \pi(20)^2(40)$ $= \mathbf{16\,000\pi\ cm^3}$

From the above table, it can be seen that for a cylinder:

- **Doubling the radius increases the volume by a factor of 2^2 (4).**
  In other words, the volume is multiplied by 4.
- **Doubling the height increases the volume by a factor of 2^1.**
  In other words, the volume is multiplied by 2.
- **Doubling the height and the radius increases the volume by a factor of 8.**
  In other words, the volume is multiplied by 8.

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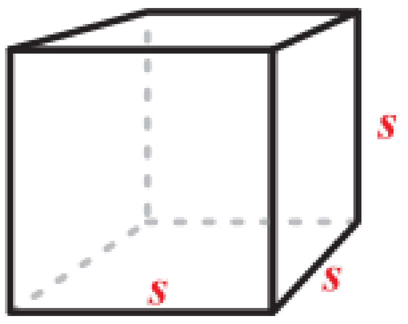
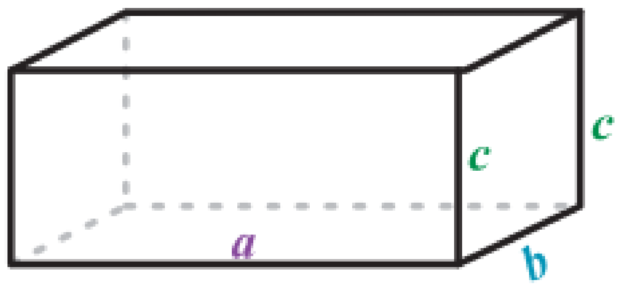
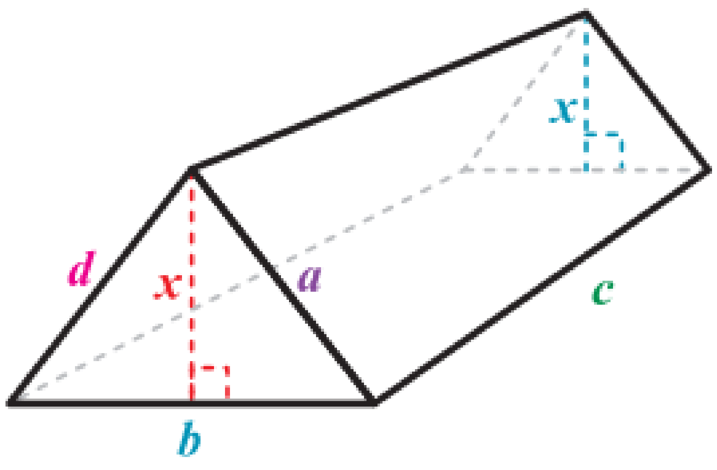
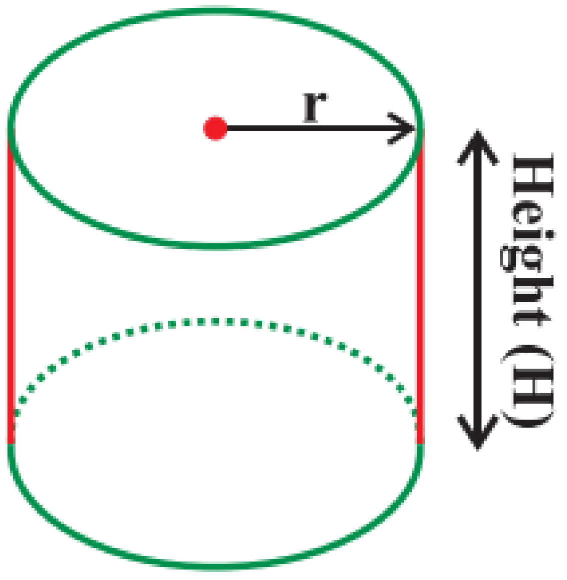
D. SUMMARY OF FORMULAS

Shape	Surface Area	Volume
Cube  **All sides are equal. This means that the area of all six faces are the same.**	$SA = 6(s)^2$	$V = (s)^3$
Rectangular prism (cuboid)  **There are a total of 6 faces. When calculating surface area add the area of each face together.**	$SA = 2(ab) + 2(ac) + 2(bc)$	$V = a \times b \times c$
Triangular prism 	$SA = ac + dc + bc + 2 \times \frac{1}{2}(b \times x)$ $= ac + dc + bc + bx$	$V = \frac{1}{2}(b \times x) \times c$
	**closed cylinder:** $SA = 2\pi rH + 2\pi r^2$ **cylinder open on one end:** $SA = 2\pi rH + \pi r^2$ **cylinder open on both ends :** $SA = 2\pi rH$	$V = \pi r^2 \times H$

Complete The Mixed Exercise on pages 363 and 364.

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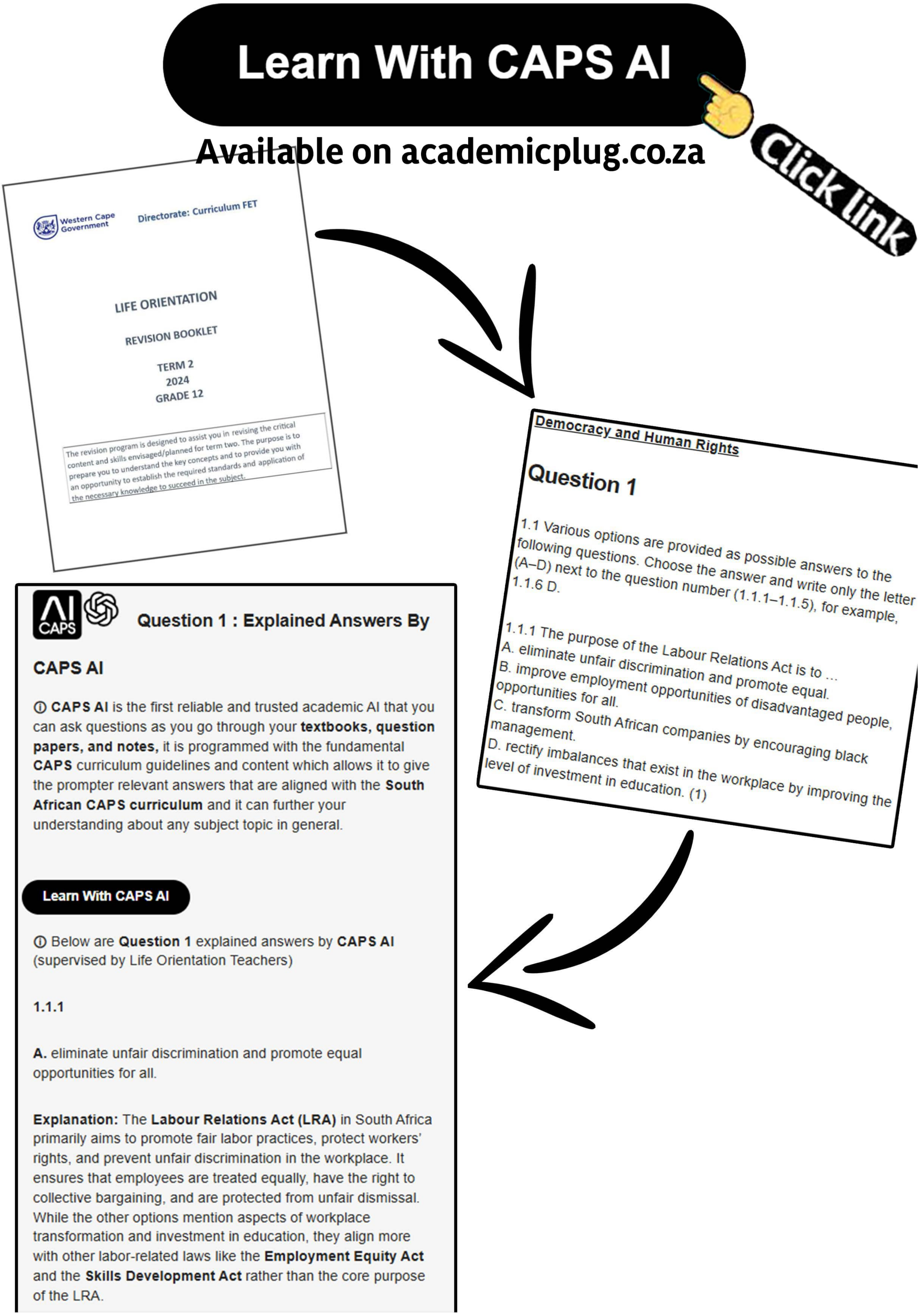
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Democracy and Human Rights
Question 1
1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.
1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)
AI CAPS
Question 1 : Explained Answers By CAPS AI
CAPS AI is the first reliable and trusted academic AI that you can ask questions as you go through your textbooks, question papers, and notes, it is programmed with the fundamental CAPS curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the South African CAPS curriculum and it can further your understanding about any subject topic in general.
Learn With CAPS AI
Below are Question 1 explained answers by CAPS AI (supervised by Life Orientation Teachers)
1.1.1
A. eliminate unfair discrimination and promote equal opportunities for all.
Explanation: The Labour Relations Act (LRA) in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the Employment Equity Act and the Skills Development Act rather than the core purpose of the LRA.

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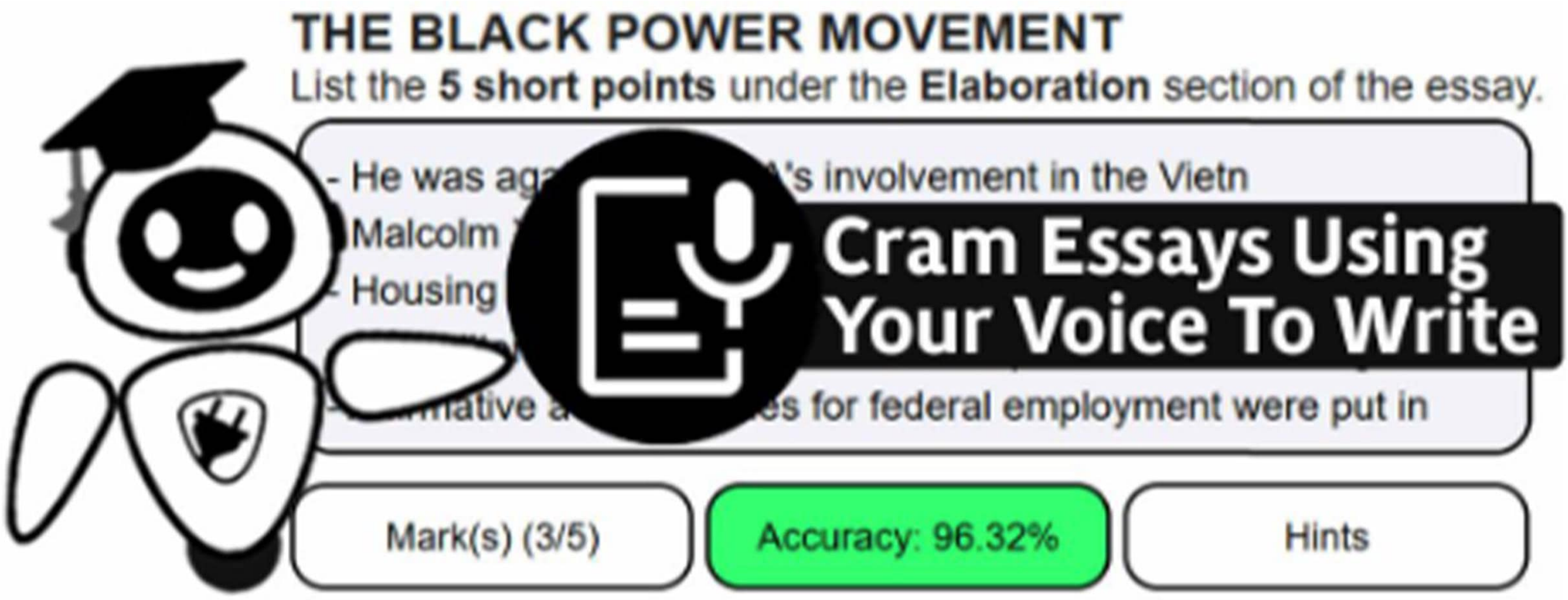

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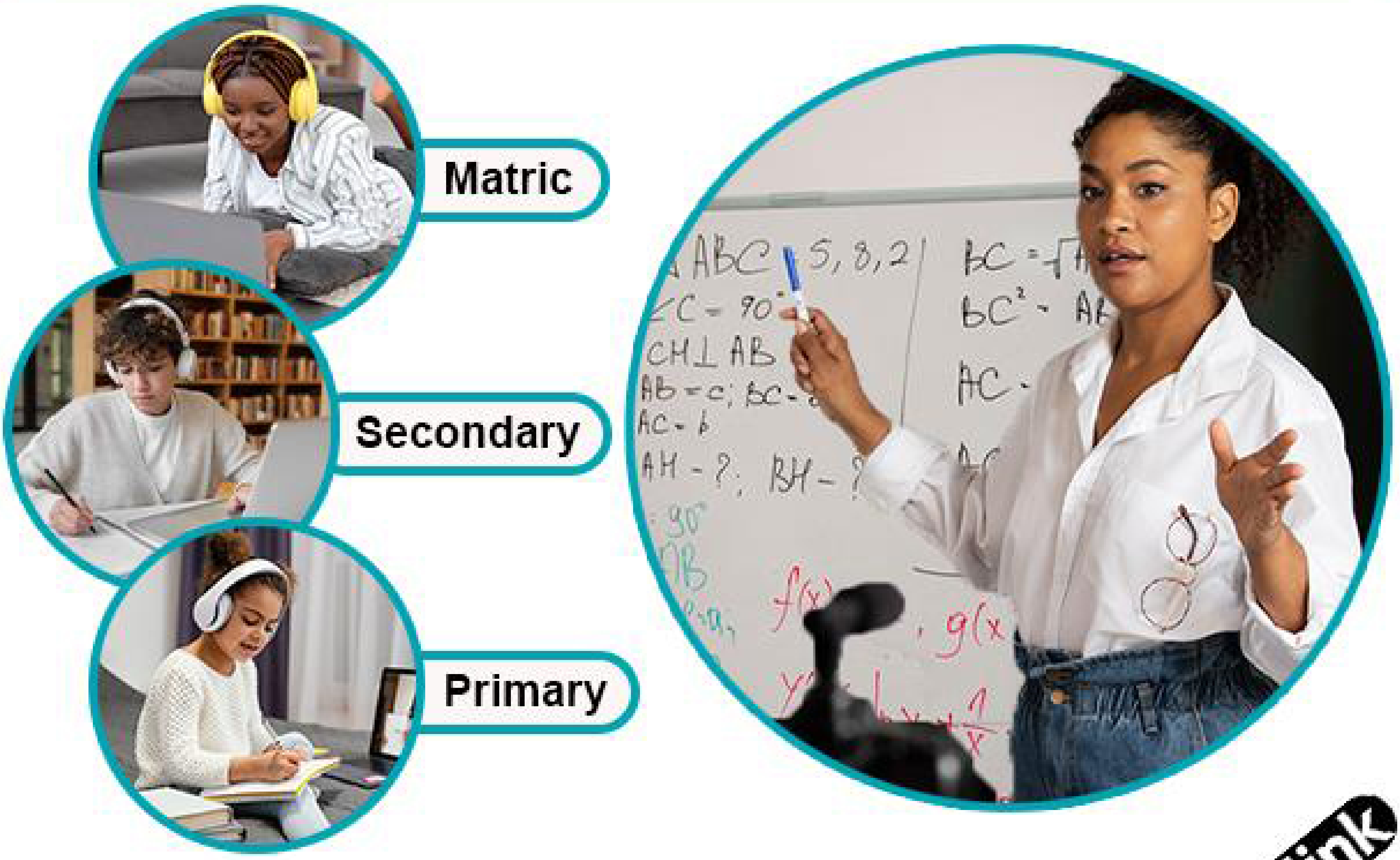

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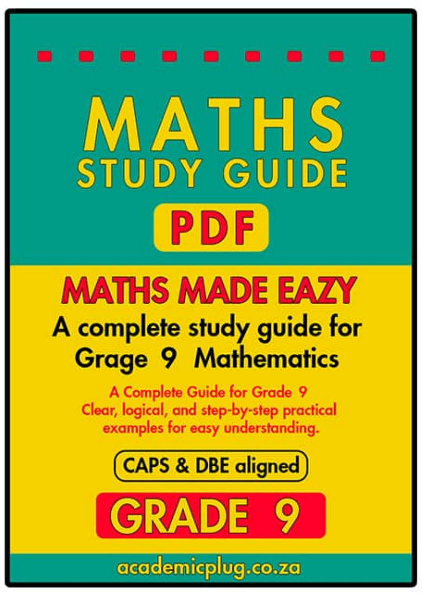

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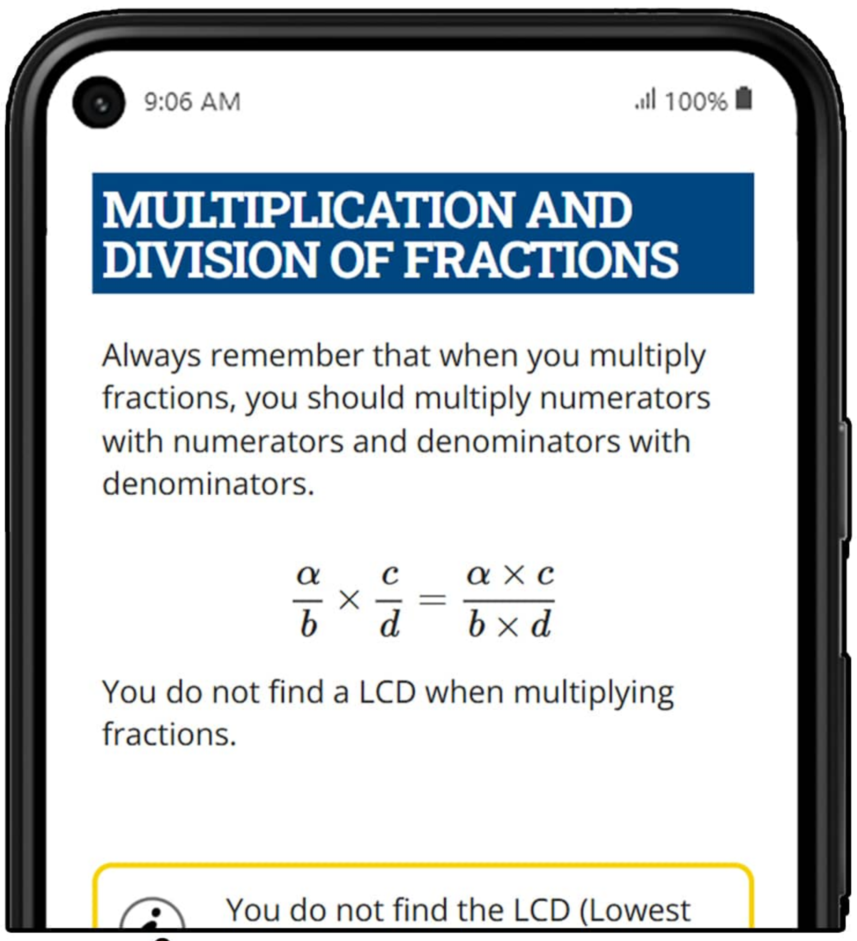

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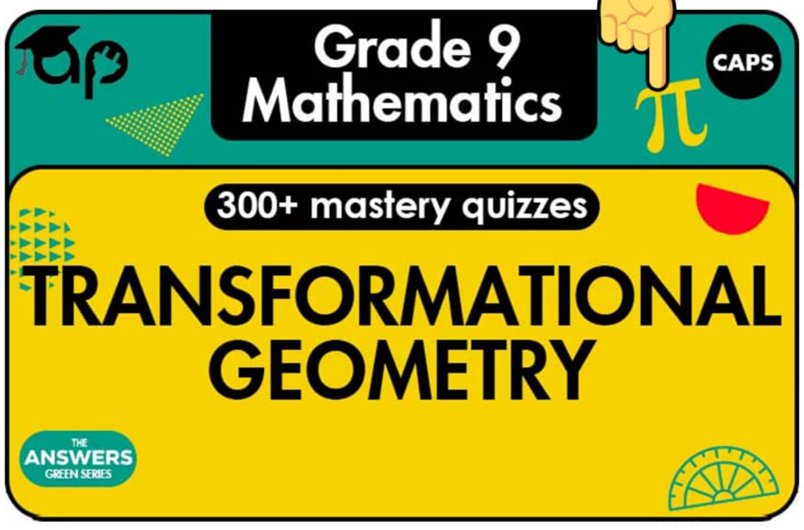

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CHAPTER 18
TRANSFORMATIONAL GEOMETRY

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
192	**A. Transformations**	4.2	• Recognize, describe and perform transformations with points, line segments and simple geometric figures on a co-ordinate plane focusing on reflections in the y-axis or x-axis, translations within and across quadrants and reflections in the line $y = x$.
192	• Translations		• Identify what the transformation of a point is, if given the co-ordinates of its image
194	• Reflections		• Use proportion to describe the effect of enlargements or reductions on area and perimeter of geometric figures
197	• Enlargements		• Investigate the co-ordinates of the vertices of figures that have been enlarged or reduced by a given scale factor
200	**B. Summary of Transformations**		
200	• Translations and Reflections:		
200	• Enlargements:		
200	• Scale Factors:		

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A. TRANSFORMATIONS

There are three types of transformations you will learn in Grade 9:
1. **Translations**
2. **Reflections**
3. **Enlargements**

1. TRANSLATIONS

Translations are:
- **Horizontal movements** (left or right).
- **Vertical movement** (up or down).
- **A combination of vertical and Horizontal movements**.

Horizontal Movements add to or subtract from the *x*-values of a point:

$$P(x;y) \rightarrow P'(x+a;y)$$

If P is shifted right you add *a* to the *x*-values.
If P is shifted left you subtract *a* from the *x*-value.

We say that the *P* has been mapped onto *P'* by the rule:

$$(x;y) \rightarrow (x+a;y)$$

***P'* is called the image of *P*.**

Example 1: Point A(5 ; 2) is translated 3 units right to give the image A'. Write down the coordinates of A'.

The image of A is:

$A'(5+3;2) \rightarrow$ 3 is **added** to the x-value as you are **shifting right**

$= A'(8;2)$

Example 2: Point A(5 ; 2) is translated 3 units left to give the image A'. Write down the coordinates of A'.

The image of A is:

$A'(5-3;2) \rightarrow$ 3 is **subtracted** from the x-value as you are **shifting left**

$= A'(2;2)$

Vertical Movements add to, or subtract from the *y*-values of a point:

$$P(x;y) \rightarrow P'(x;y+b)$$

If P is shifted up you add *b* to the *y*-values.
If P is shifted down you subtract *b* from the *y*-value.

Example 3: Point P(5 ; 2) is translated 3 units up to give the image P'. Write down the coordinates of P'.

The image of P is:

$P'(5;2+3) \rightarrow$ 3 is **added** to the y-value as you are **shifting up**

$= P'(5;5)$

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Example 4: **Point P(5 ; 2) is translated 3 units down to give the image P'. Write down the coordinates of Q'.**

The image of P is:

$Q'(5\,;2-3) \rightarrow$ 3 is **subtracted** from the y-value as you are **shifting down**

$= Q'(5;-1)$

Example 5: **Point Q(5 ; 2) is translated 8 units left and 4 units up to give the image Q'. Write down the coordinates of P'.**

The image of Q is:

$Q'(5-8\,;2+4) \rightarrow$ shifting **left you subtract**, shifting **up you add**

$= Q'(-3;6)$

Example 6: **ΔABC has vertices of $A(-4;5)$, $B(-1;1)$ and $C(2;6)$.**

a) Determine the coordinates of ΔA'B'C', which is the image of ΔABC after it has been translated 4 units right and 5 units down.

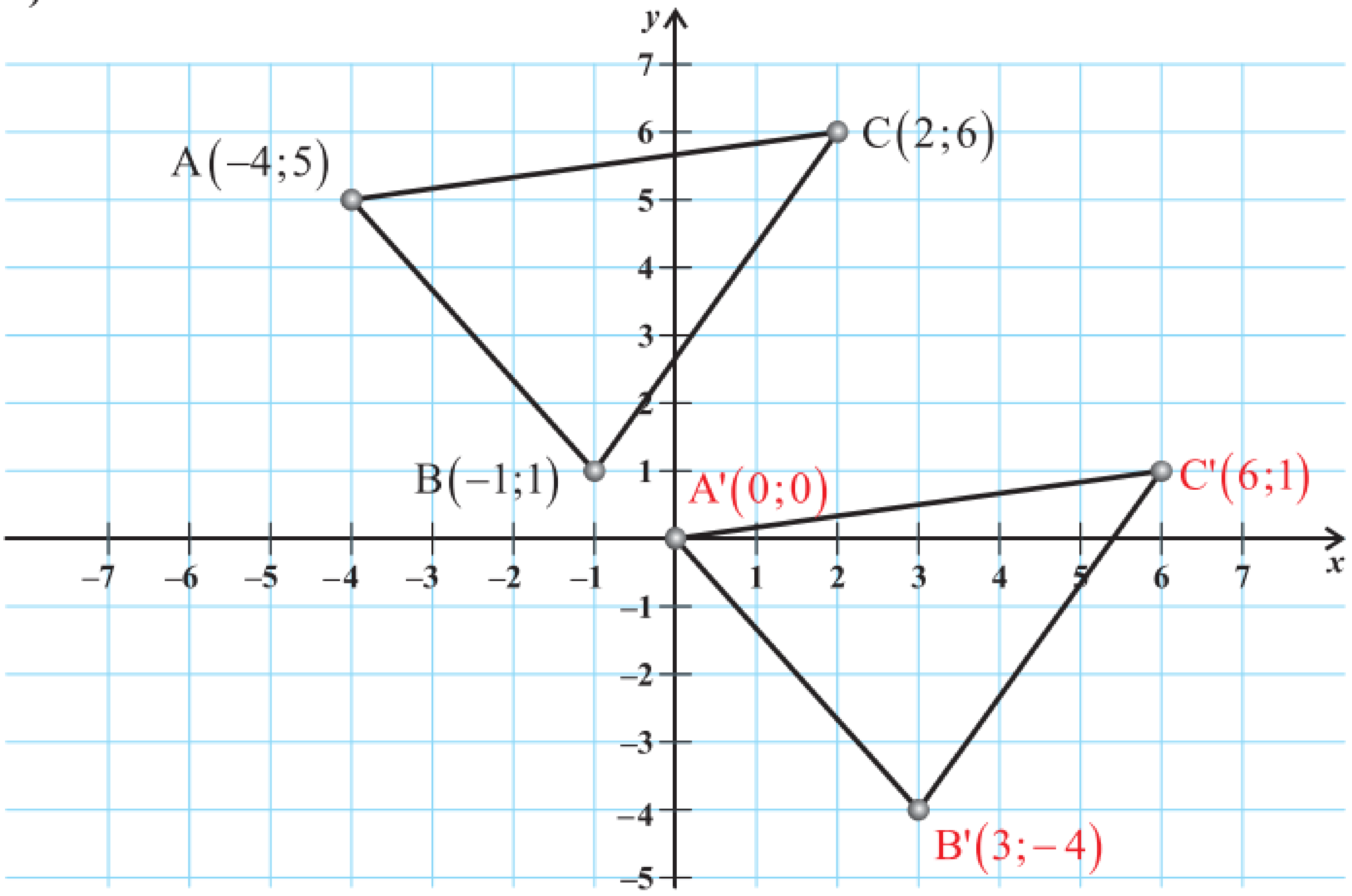
b) Draw ΔABC and ΔA'B'C' on a Cartesian Plane

a) $A'(0;0) \rightarrow (-4+4;5-5)$

$B'(3;-4) \rightarrow (-1+4;1-5)$

$C'(6;1) \rightarrow (2+4;6-5)$

b)



Translating a figure does not change the shape or size of the figure.
Figures which have been translated are always congruent.
This means that the figures are the same in terms of shape and size.
In other words, the ratio of $\frac{AB}{A'B'} = 1$.

Complete Exercise 1 on page 369.

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2. REFLECTIONS

There are 3 types of reflections you will learn in Grade 9:
- **Reflections about the x-axis.**
- **Reflections about the y-axis.**
- **Reflections about the line $y = x$.**

REFLECTIONS ABOUT THE x - AXIS

A **Reflection** about the **x-axis changes** the **sign of** the **y-value**.
The x-value does not change when reflecting about the x-axis.

Reflection about the x-axis
$$P(x;y) \rightarrow P'(x;-y)$$

Example 1: **Point A(5 ; 2) is reflected about the x-axis to give the image A'. Write down the coordinates of A'.**

The image of A is:
$A'(5;-2) \rightarrow$ the y-value becomes negative when reflecting about the x-axis

A reflection about the x-axis is a reflection about the line $y = 0$.

REFLECTIONS ABOUT THE y - AXIS

A **Reflection** about the **y-axis changes** the **sign of** the **x-value**.
The y-value does not change when reflecting about the x-axis.

Reflection about the y-axis
$$P(x;y) \rightarrow P'(-x;y)$$

Example 2: **Point A(5 ; 2) is reflected about the y-axis to give the image A'. Write down the coordinates of A'.**

The image of A is:
$A'(-5;2) \rightarrow$ the x-value becomes negative when reflecting about the y-axis

A reflection about the y-axis is a reflection about the line $x = 0$.

REFLECTIONS ABOUT THE LINE $y = x$

A **Reflection** about the line **$y = x$, swaps the x and y-values**.

Reflection about the line $y = x$
$$P(x;y) \rightarrow P'(y;x)$$

Example 3: **Point A(5 ; 2) is reflected about the line $y = x$ to give the image A'. Write down the coordinates of A'.**

The image of A is:
$A'(2;5) \rightarrow$ the x and y-values swap when reflecting about the line $y = x$

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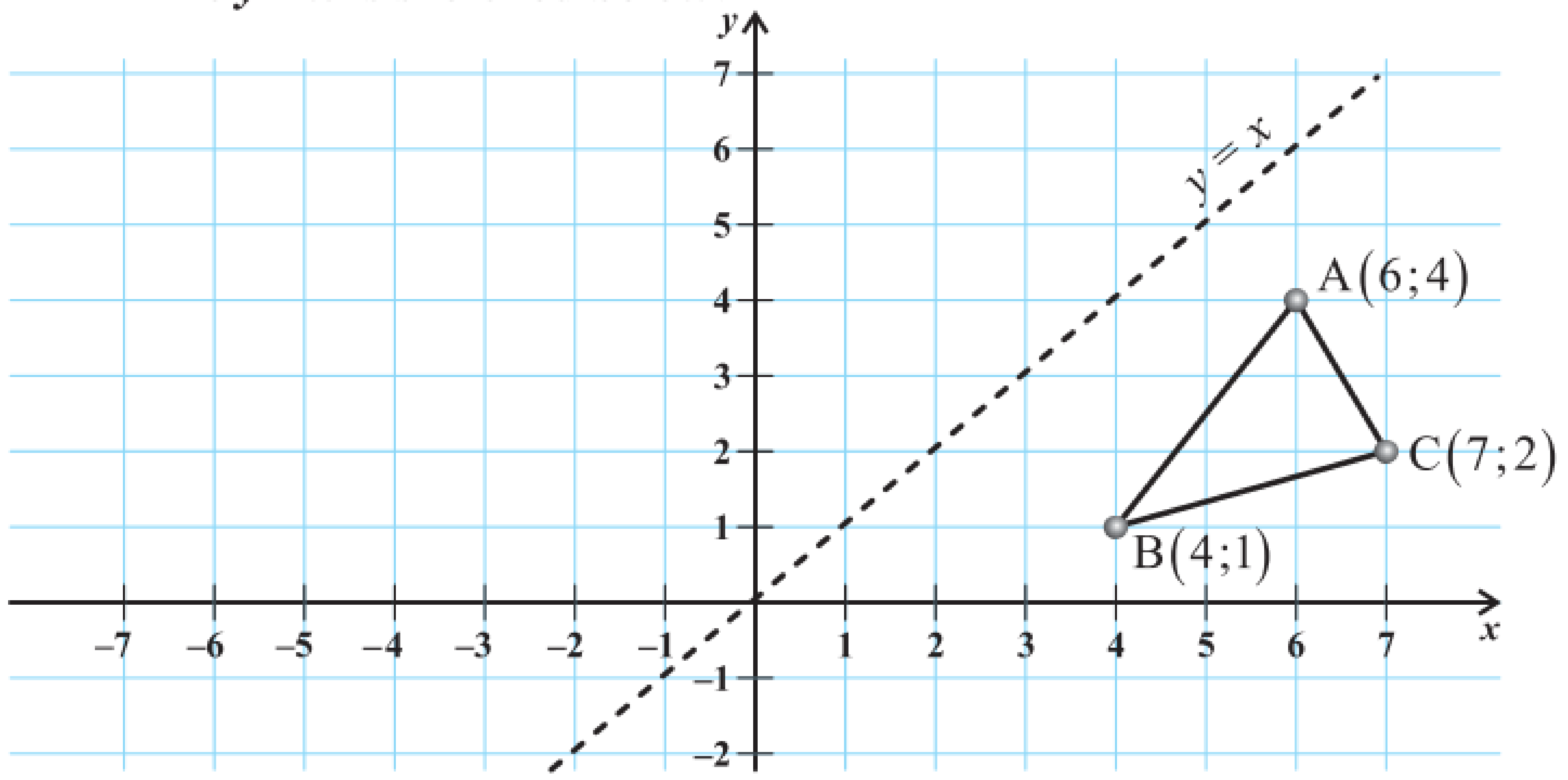
Example 4: ΔABC has vertices of $A(6;4)$, $B(4;1)$ and $C(7;2)$. ΔABC and the dotted line $y = x$ is sketched below:



a) **Determine the coordinates of ΔA'B'C', which is the image of ΔABC after it has been reflected about the *x*-axis.**

b) **Determine the coordinates of ΔA''B''C'', which is the image of ΔABC after it has been reflected about the *y*-axis.**

c) **Determine the coordinates of ΔA'''B'''C''', which is the image of ΔABC after it has been reflected about the *y*-axis.**

d) **Draw ΔA'B'C', ΔA''B''C'', and ΔA'''B'''C''' on a Cartesian Plane**

a) Reflection about the *x*-axis, *y*-values become negative:

$A'(6;-4)$

$B'(4;-1)$

$C'(7;-2)$

b) Reflection about the *y*-axis, *x*-values become negative:

$A''(-6;4)$

$B''(-4;1)$

$C''(-7;2)$

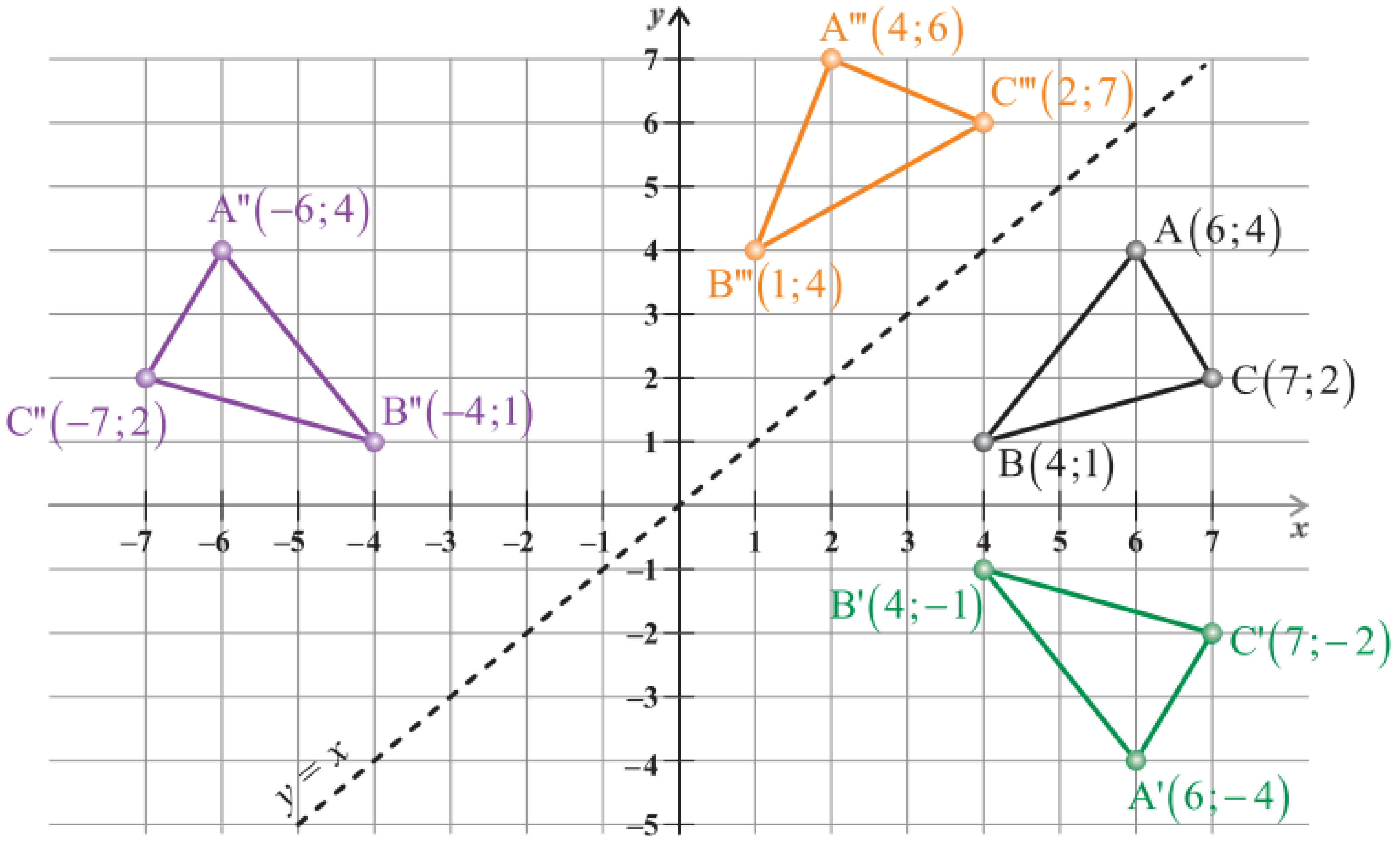
c) Reflection about the line $y = x$, *x* and *y*-values swap:

$A'''(4;6)$

$B'''(1;4)$

$C'''(2;7)$

d)



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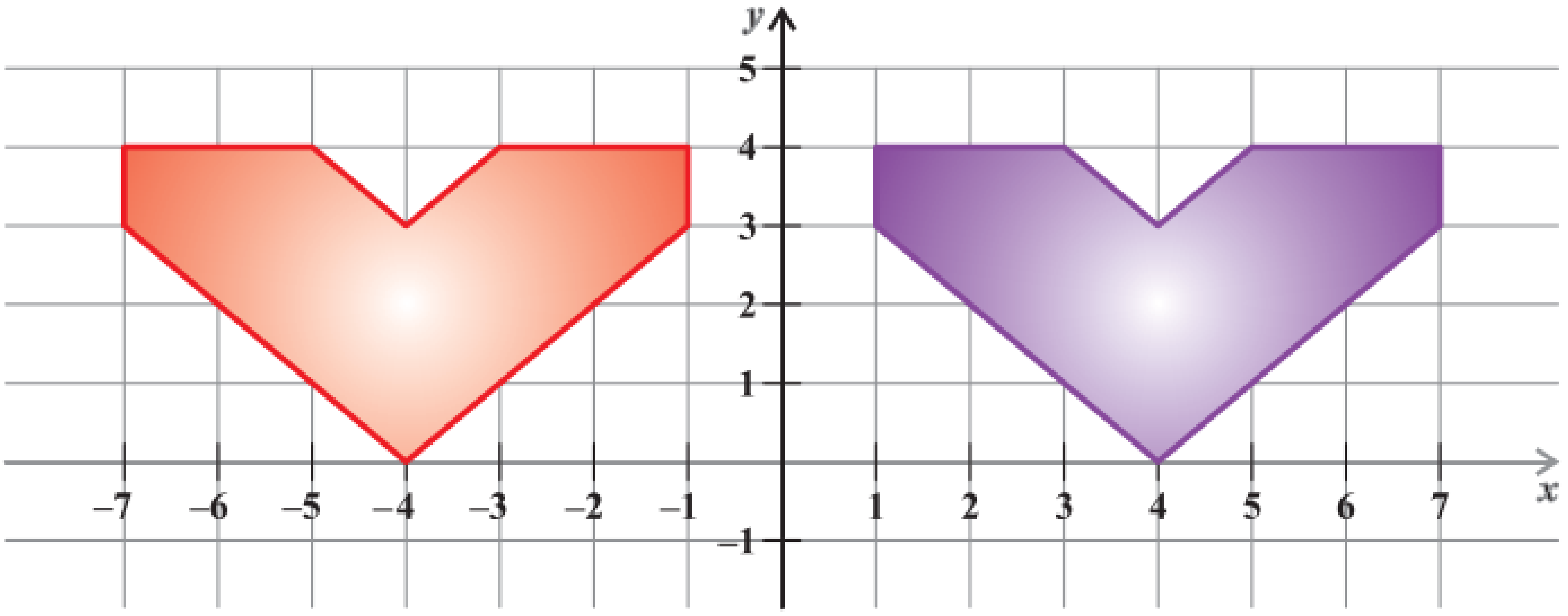
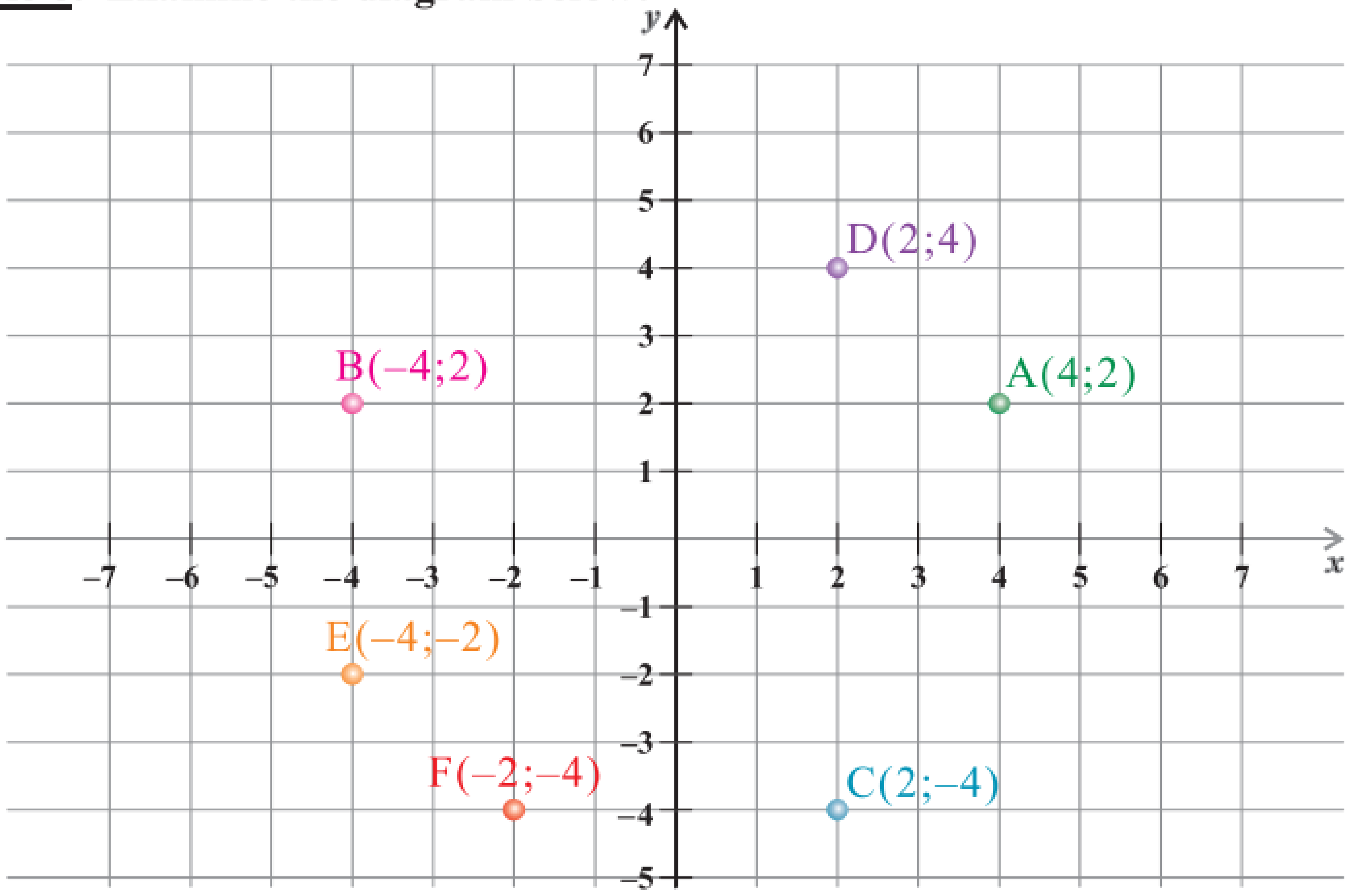
Example 5: **The purple heart below was formed by reflecting the red heart. What reflection has taken place from the red heart to the purple heart?**



From the red heart to the purple heart, the x-values have changed signs while the y-values have remained the same.

This is a reflection about the y-axis.

Example 6: **Examine the diagram below:**



What type of reflection has taken place to obtain point:

a) **B from A?**
b) **D from A?**
c) **B from C?**
d) **B from E?**
e) **D from C?**
f) **C from F?**

a) Reflection about the y-axis.
b) Reflection about the line $y = x$.
c) Reflection about the line $y = x$.
d) Reflection about the x-axis.
e) Reflection about the x-axis.
f) Reflection about the y-axis.

Reflecting a figure always results in a congruent figure. This is because reflecting a figure does not change the shape or size of the figure.

Complete Exercise 2 on page 370.

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3. ENLARGEMENTS

The image of a figure that is **enlarged or reduced by a scale factor of *k***, has the **same shape but is a larger or smaller size**.

Each side of the new shape is enlarged or reduced by the same amount to form the new shape which is called the image.

Enlargements:

$$P(x;y) \rightarrow P'(kx;ky)$$

Example 1: Point A(6 ; –2) is enlarged by a factor of 2 to give the image A'. Write down the coordinates of A'.

The image of A is:

$A'(12;-4) \rightarrow$ the x and y-values are multiplied by 2

Example 2: Point A(6 ; –2) is enlarged by a factor of $\frac{1}{2}$ to give the image A'. Write down the coordinates of A'.

The image of A is:

$A'(3;-1) \rightarrow$ the x and y-values are multiplied by $\frac{1}{2}$ (this is the same as dividing by 2)

If the scale factor is less than 1 the image of the point or figure will be smaller than the original.

If the scale factor is larger than 1 the image of the point or figure will be bigger than the original.

Example 3: Point A(6 ; –2) is reduced by a factor of 2 to give the image A'. Write down the coordinates of A'.

The image of A is:

$A'(3;-1) \rightarrow$ the x and y-values are divided by 2 $\left(\text{this is the same as multiplying by a } \frac{1}{2}\right)$

An enlargement by a factor of $\frac{1}{k}$ is the same as a reduction by a factor of *k*.

Example 4: Point Q(–3 ; –5) is enlarged by a factor of 5 to give the image Q'. Write down the coordinates of Q'.

The image of Q is:

$Q'(-15;-25) \rightarrow$ the x and y-values are multiplied by 5

Example 5: Point P(3 ; –9) is enlarged by a factor of $\frac{1}{3}$ to give the image P'. Write down the coordinates of P'.

The image of P is:

$P'(1;-3) \rightarrow$ the x and y-values are multiplied by $\frac{1}{3}$ (this is the same as dividing by 3)

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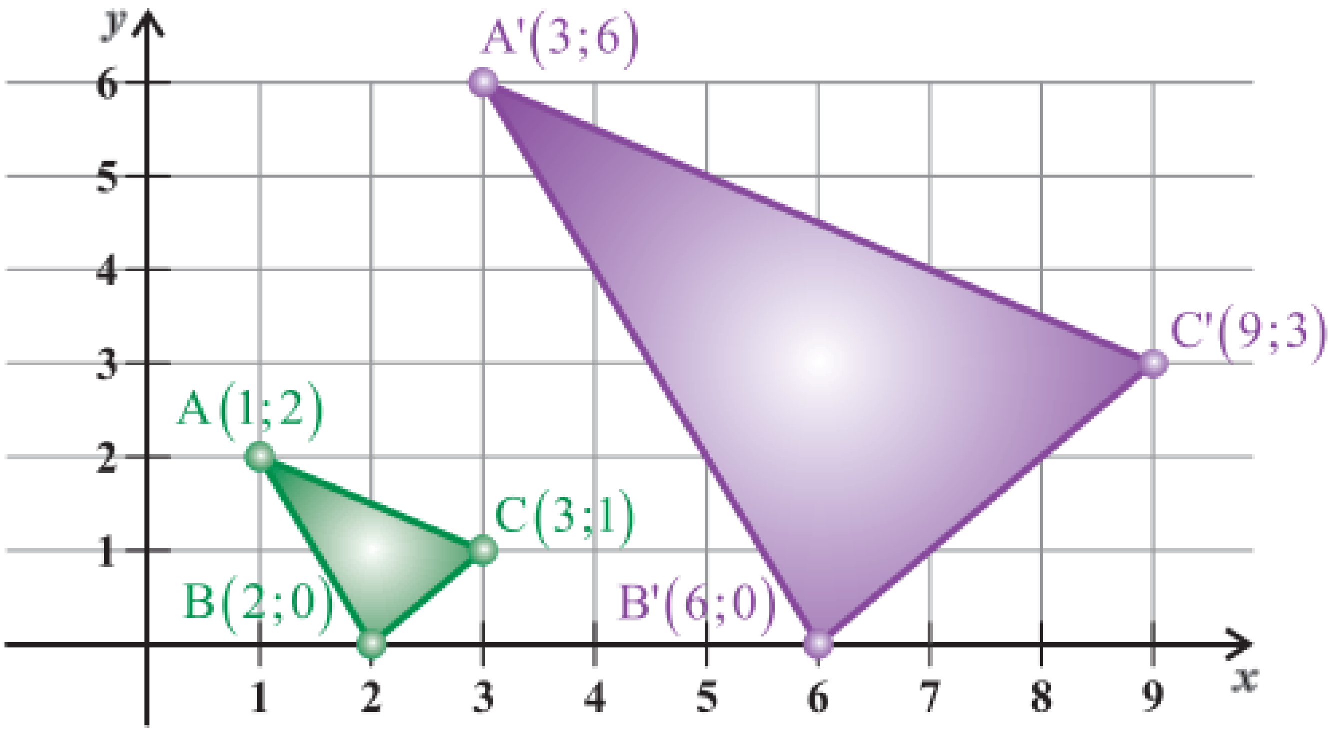
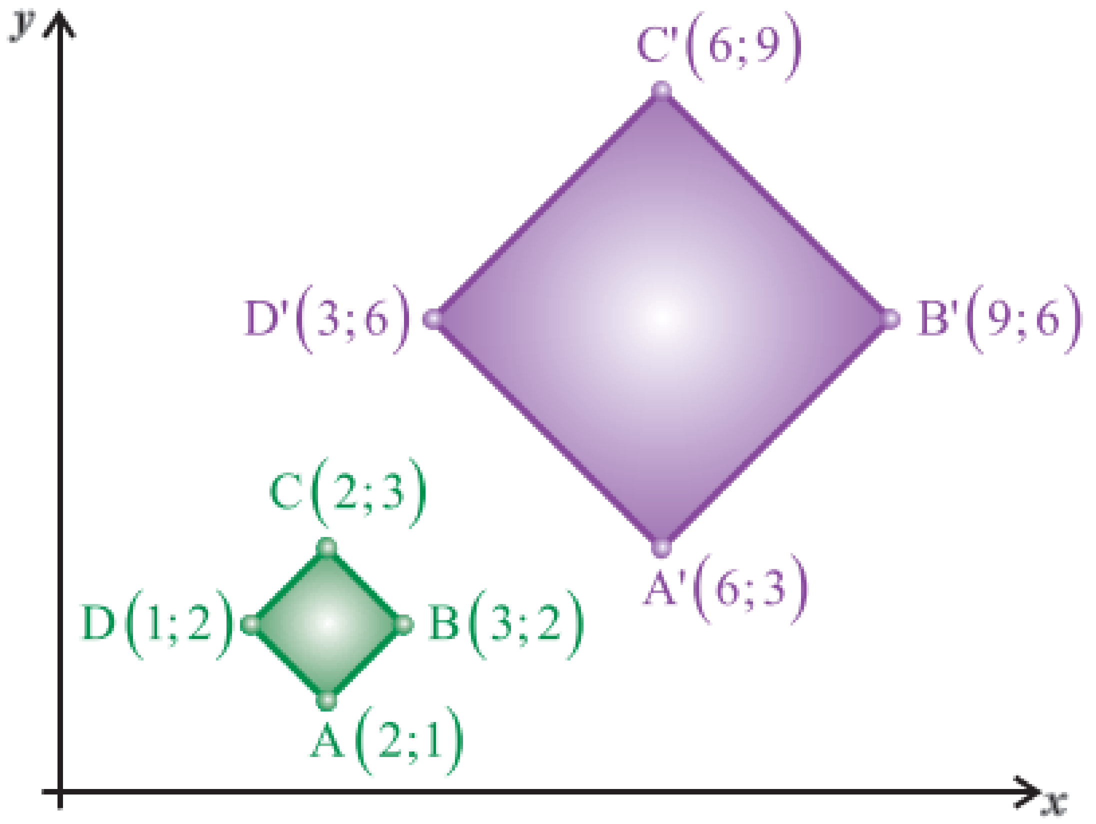
Example 6: ΔABC has vertices A(1;2), B(2;0) and C(3;1). ΔA'B'C' is the image of ΔABC after an enlargement by a scale factor of 3. Sketch ΔABC and its image ΔA'B'C' on a Cartesian plane.



Example 7: The diagram below shows square ABCD and its image A'B'C'D'. The length of a side of square ABCD is $\sqrt{2}$ units.



a) What factor has ABCD been enlarged by to obtain A'B'C'D'?
b) What is the length of one side of square A'B'C'D'?
c) Determine the area of ABCD and A'B'C'D'.
d) Determine the ratio of $\frac{\text{Area of A'B'C'D'}}{\text{Area of ABCD}}$.

a) To determine the scale factor of enlargement, choose any two corresponding points in the original figure and the image and divide them:

$$\frac{A'}{A} = \left(\frac{6}{2}; \frac{3}{1}\right)$$

$= (3;3) \rightarrow$ the x and y-values have been multiplied by 3 to obtain A' from A

$\therefore$ ABCD has been enlarged by a factor of 3

b) The length of each side of the image will be enlarged by a factor of 3.
$\therefore$ The length of each side of square A'B'C'D' is $3\sqrt{2}$ units

c) $A_{ABCD} = \sqrt{2} \times \sqrt{2}$
$= 2 \text{ units}^2$

$A_{A'B'C'D'} = 3\sqrt{2} \times 3\sqrt{2}$
$= 18$

d) $\frac{A_{A'B'C'D'}}{A_{ABCD}} = \frac{18}{2} = 9 \rightarrow$ note that 9 is 3^2

If a figure is enlarged by a factor of k, the area is enlarged by a factor of k^2.

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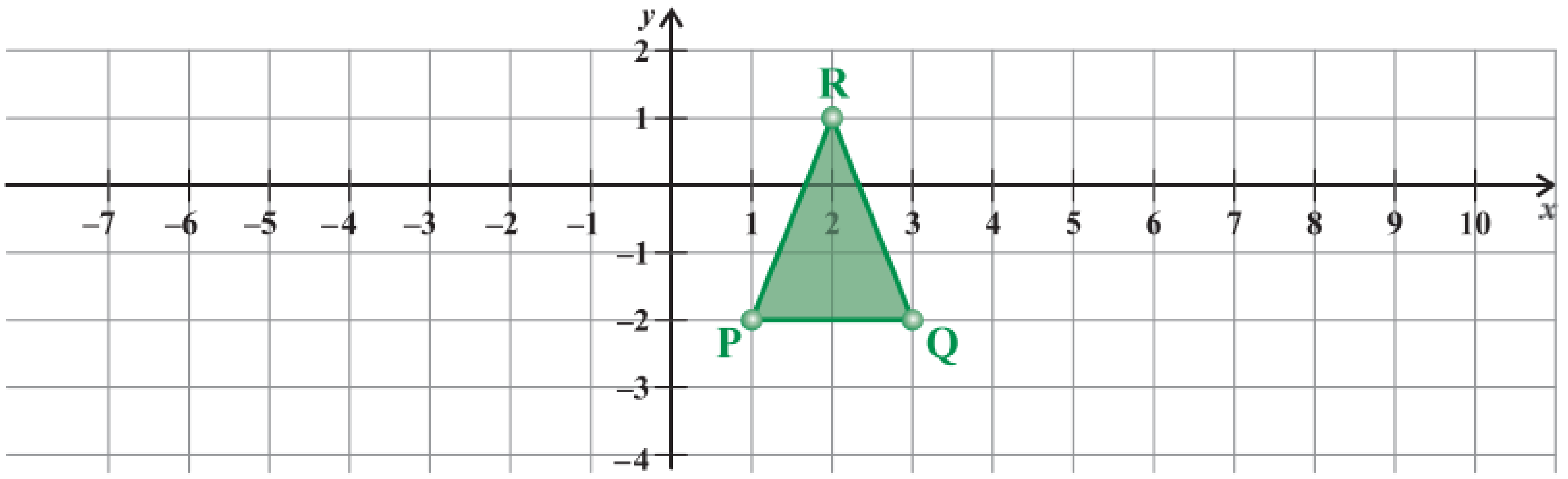
Example 8: The diagram below shows ΔPQR with vertices $P(1;-2)$, $Q(3;-2)$ and $R(2;1)$.



a) Calculate the area of ΔPQR.

b) Draw the image of ΔPQR after an enlargement by a factor of 2. Label the vertices of the image P', Q' and R'.

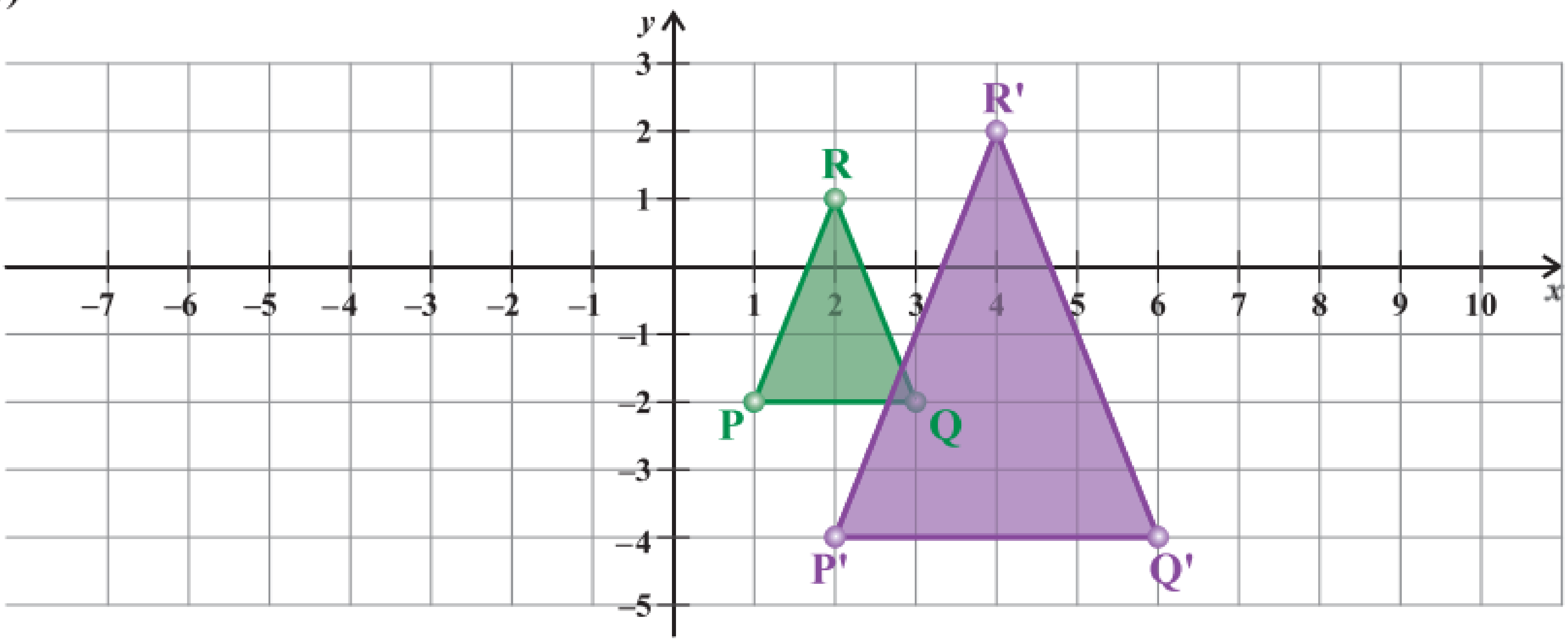
c) What is the value of $\dfrac{PR}{P'R'}$?

d) What is the value of $\dfrac{\text{perimeter } \Delta P'Q'R'}{\text{perimeter } \Delta PQR}$?

e) What is the value of $\dfrac{\text{area } \Delta P'Q'R'}{\text{area } \Delta PQR}$?

a) $$\begin{aligned}\text{Area} &= \frac{1}{2}(\text{base} \times \perp \text{height}) \\ &= \frac{1}{2}(2 \times 3) \\ &= 3\,\text{units}^2\end{aligned}$$

b)



c) $\dfrac{PR}{P'R'} = \dfrac{1}{2} \rightarrow$ the lengths of the sides of ΔPQR is $\dfrac{1}{2}$ the lengths of the sides of $\Delta P'Q'R'$

d) $\dfrac{\text{perimeter } \Delta P'Q'R'}{\text{perimeter } \Delta PQR} = 2 \rightarrow$ the perimeter of $\Delta P'Q'R'$ is 2 times the perimeter of ΔPQR

e) $\dfrac{\text{area } \Delta P'Q'R'}{\text{area } \Delta PQR} = 4 \rightarrow$ area increases by a factor of 2^2

Complete Exercise 3 on pages 370 and 371.

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B. SUMMARY OF TRANSFORMATIONS

Transformation	Description	Rule
Horizontal Translation	a is added to the x-value	$P(x;y) \rightarrow P'(x+a;y)$
Vertical Translation	b is added to the y-value	$P(x;y) \rightarrow P'(x;y+b)$
Horizontal and Vertical Translation	a is added to the x-value and b is added to the y-value	$P(x;y) \rightarrow P'(x+a;y+b)$
Reflection about the y-axis (the line $x = 0$)	The sign of the x-value changes and the y-value stays the same	$P(x;y) \rightarrow P'(-x;y)$
Reflection about the x-axis (the line $y = 0$)	The sign of the y-value changes and the x-value stays the same	$P(x;y) \rightarrow P'(x;-y)$
Reflection about the line $y = x$	The x and y-values swap	$P(x;y) \rightarrow P'(y;x)$
Enlargements by a factor of k	The x and y-values are multiplied by k	$P(x;y) \rightarrow P'(kx;ky)$

TRANSLATIONS AND REFLECTIONS:

- **Translations** and **reflections** result in **congruent shapes**
- If a shape is **translated** or **reflected** the **length of each line of the image is the same as the original shape**

ENLARGEMENTS:

- The image of an **enlargement** is **similar to** the **original shape**, but **not congruent**
- The **length of each line of the image of an enlarged shape** is ***k*** **times larger than the original**, where k is the scale factor of the enlargement
- The **area of the image** is $\boldsymbol{k^2}$ times **bigger** than the original

SCALE FACTORS:

The scale factor can be determined in 3 ways:

1) $k = \dfrac{\text{The length of one side of the image of the shape}}{\text{The length of the corresponding side of the original shape}}$

2) $k = \dfrac{\text{Perimeter of the image of the shape}}{\text{Perimeter of the original shape}}$

3) $\therefore k = \sqrt{\dfrac{\text{Area of the image of the shape}}{\text{Area of the original shape}}} \rightarrow k^2 = \dfrac{\text{Area of the image of the shape}}{\text{Area of the original shape}}$

Complete The Mixed Exercise on pages 371 and 372.

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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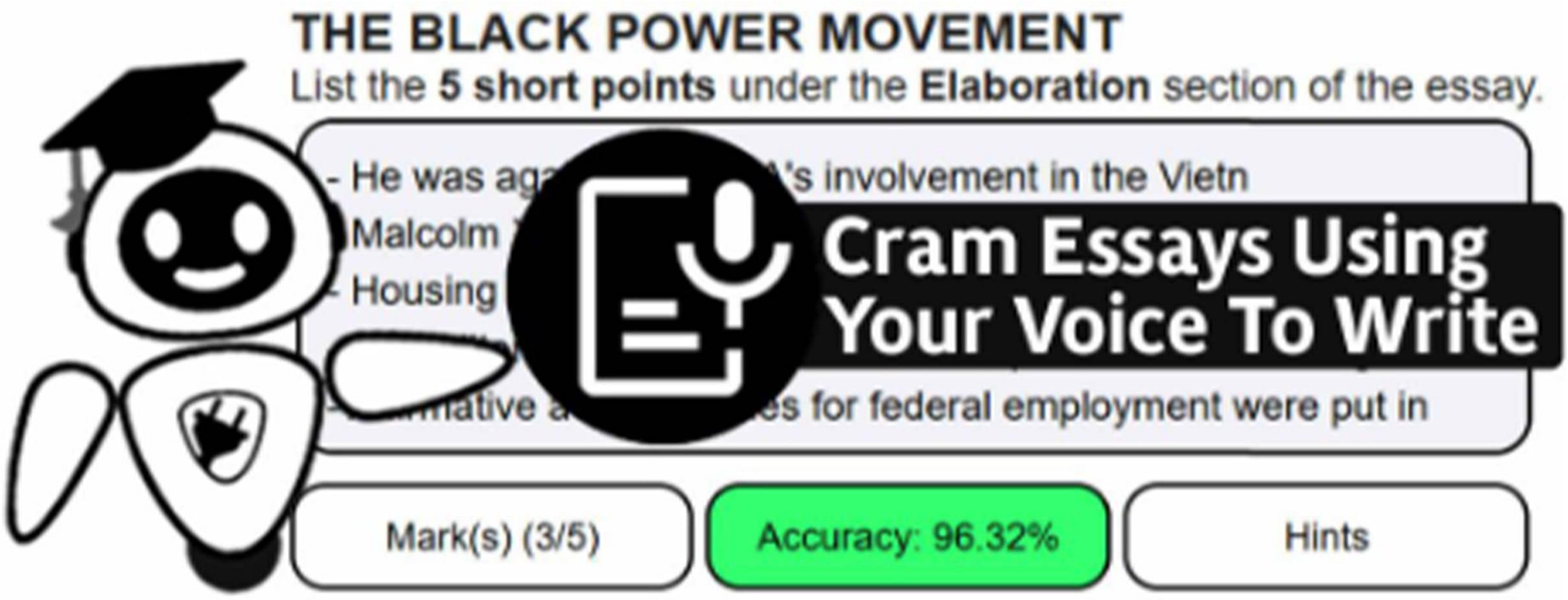

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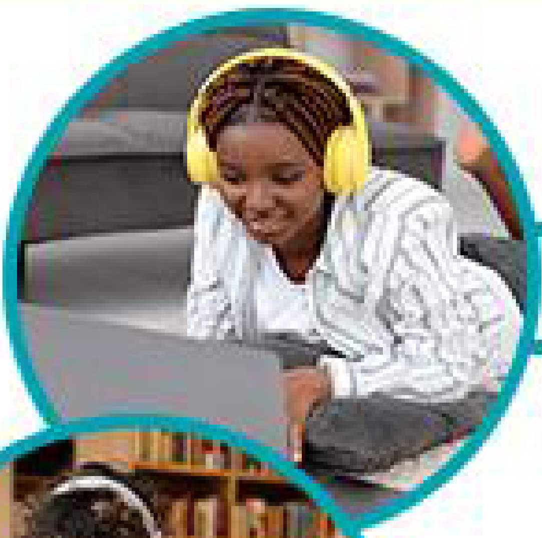

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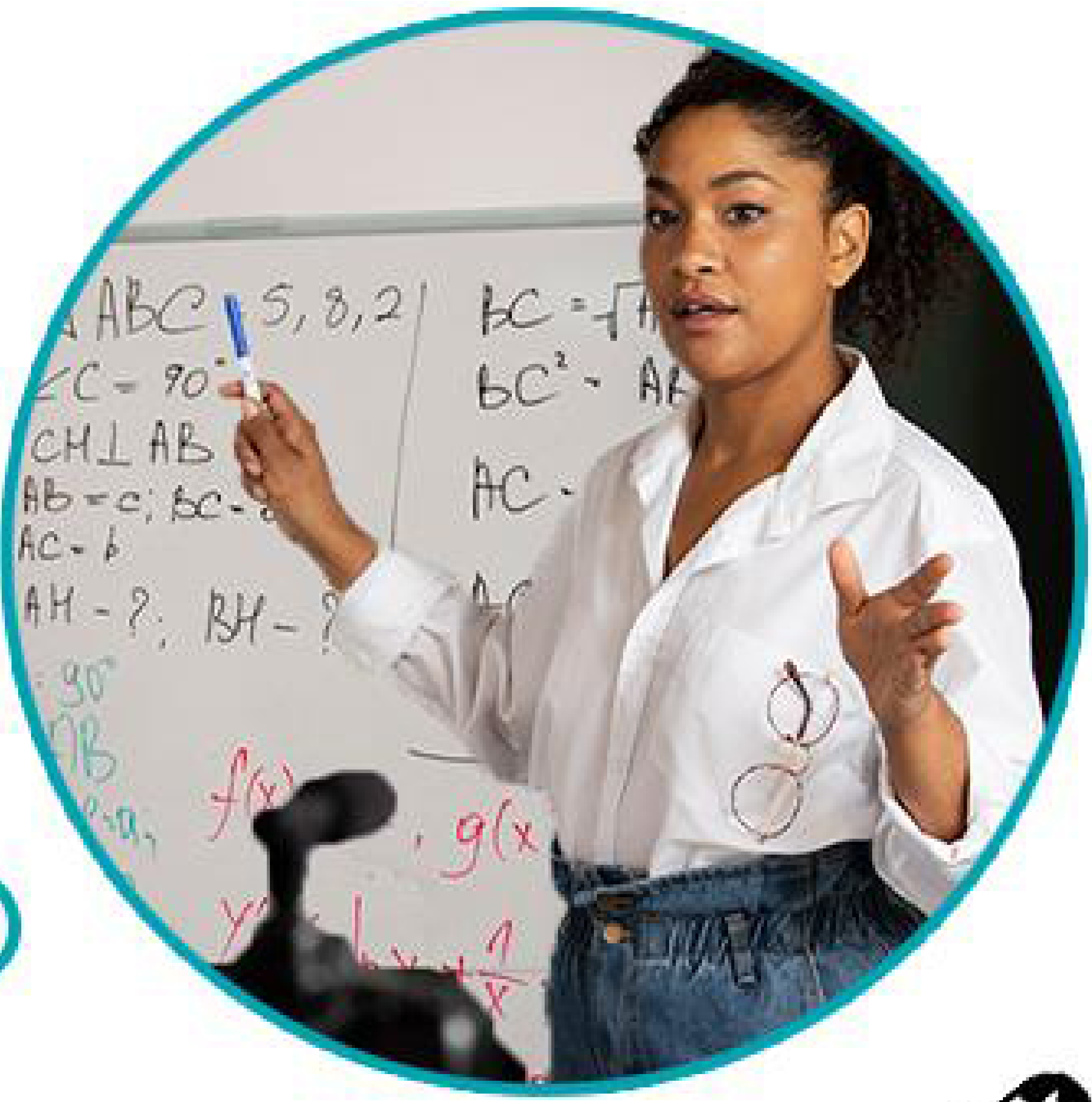

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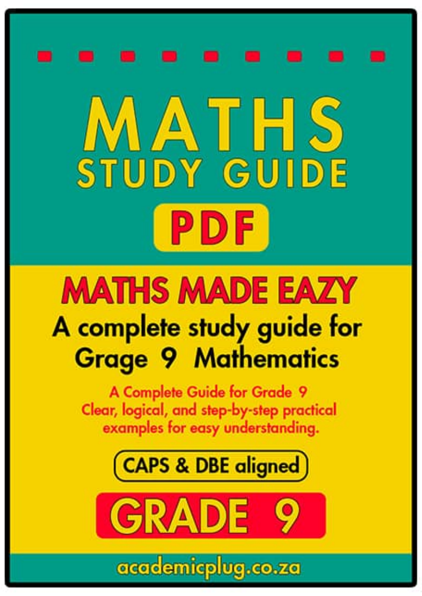

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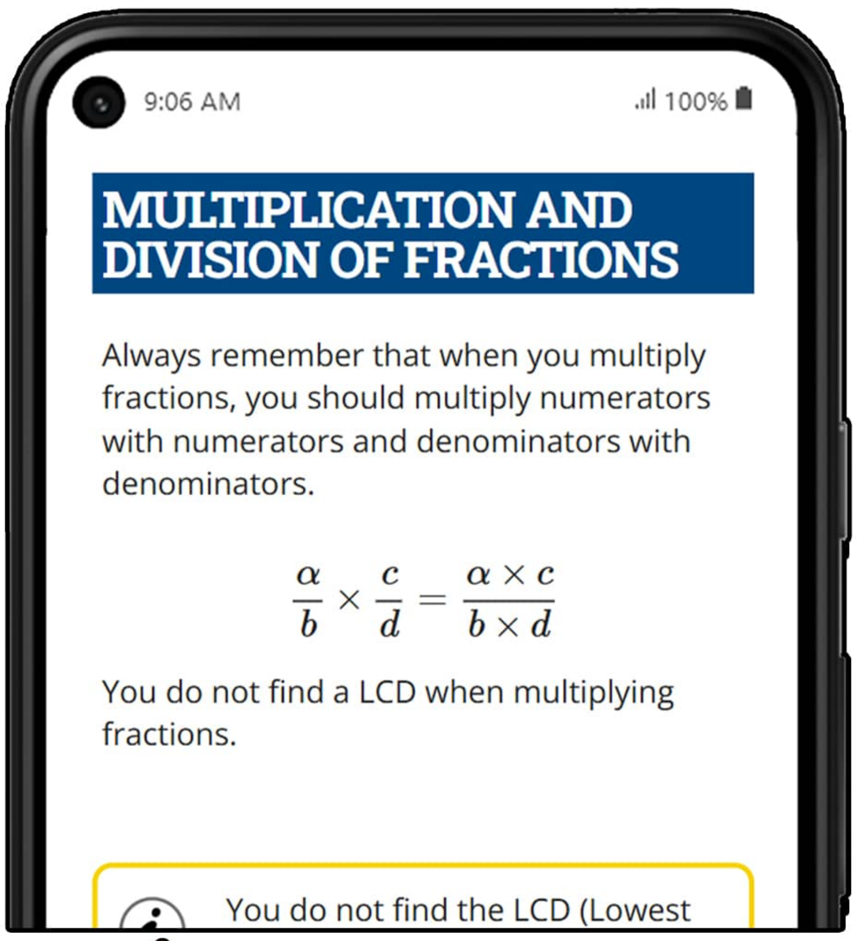

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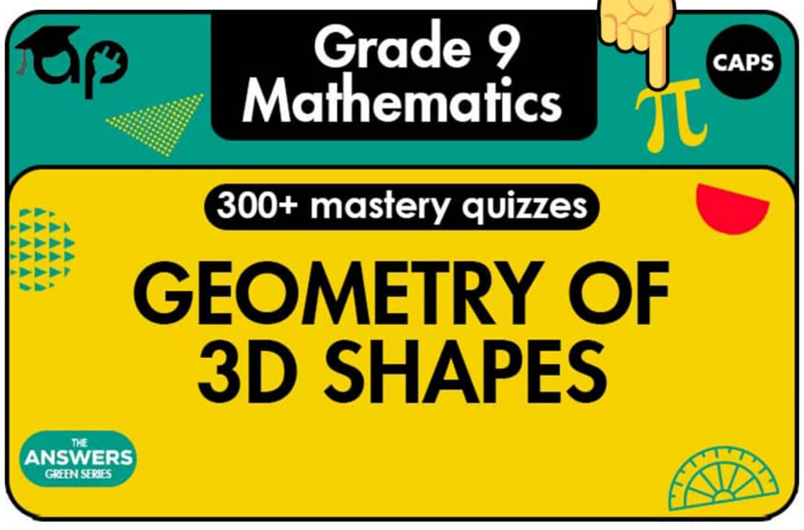

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CHAPTER 19
GEOMETRY OF 3D SHAPES

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
202	**A. Terminology**	3.2	• Describe, name and compare the 5 Platonic solids in terms of the shape and number of faces, the number of vertices and the number of edges
202	• Polygons		
202	• Regular Polygons		
202	• Angles in a Polygon		
203	• Polyhedrons		
203	• Euler's Law		• Recognise and describe the properties of spheres and cylinders
204	**B. Platonic Solids**		
205	**C. Nets of Shapes**		
206	**D. Cylinders and Spheres**		• Use nets to create models of geometric solids including cubes, prisms, pyramids and cylinders
206	• Cylinders		
206	• Spheres		

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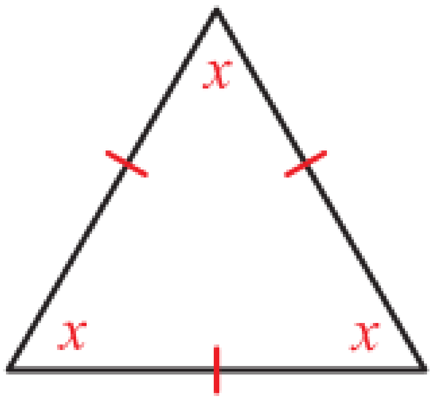
A. TERMINOLOGY

POLYGONS

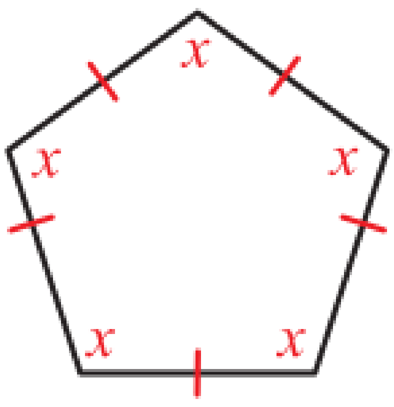
Polygons are two-dimensional (2D) closed shapes made up of **3 or more straight sides.**

REGULAR POLYGONS

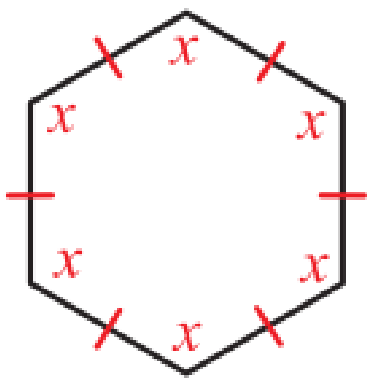
A regular polygon is a polygon in which **all sides are equal** and **all angles are equal**. Examples of regular polygons are shown below.



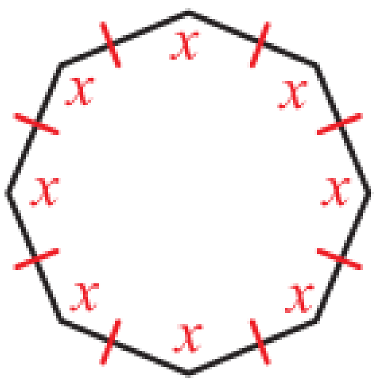
Equilateral triangle



Regular pentagon



Regular Hexagon



Regular Octagon

ANGLES IN A POLYGON

The sum of angles in any polygon:

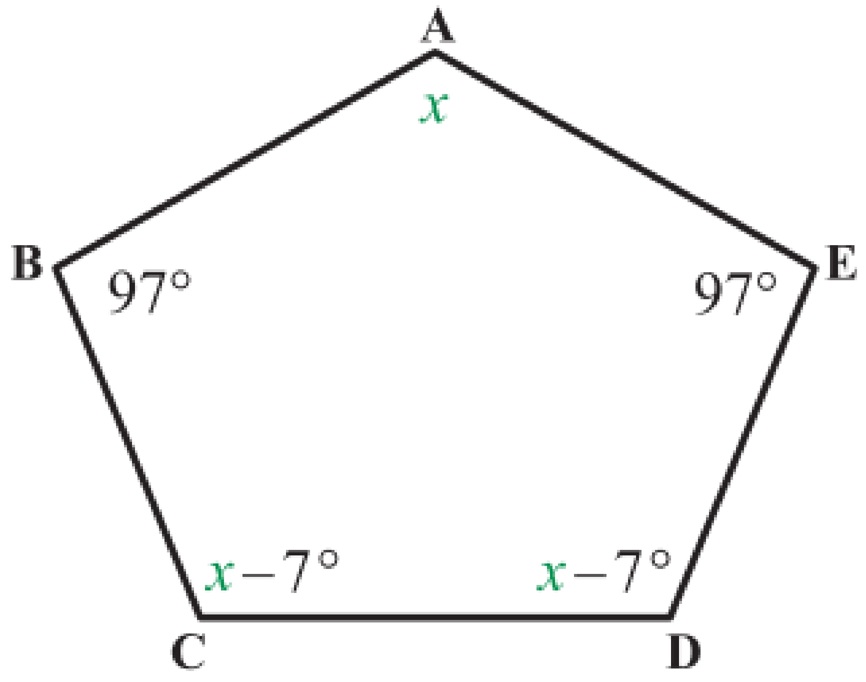
sum of angles in a polygon $= 180°(n-2)$

If the polygon is regular, the interior angles are equal:

Each interior angle of a regular polygon $= \frac{180°}{n}(n-2)$

Where: n is the number of sides of the polygon

Example 1: Determine the value of x in the diagram alongside:



Sum of interior angles $= 180°(n-2)$

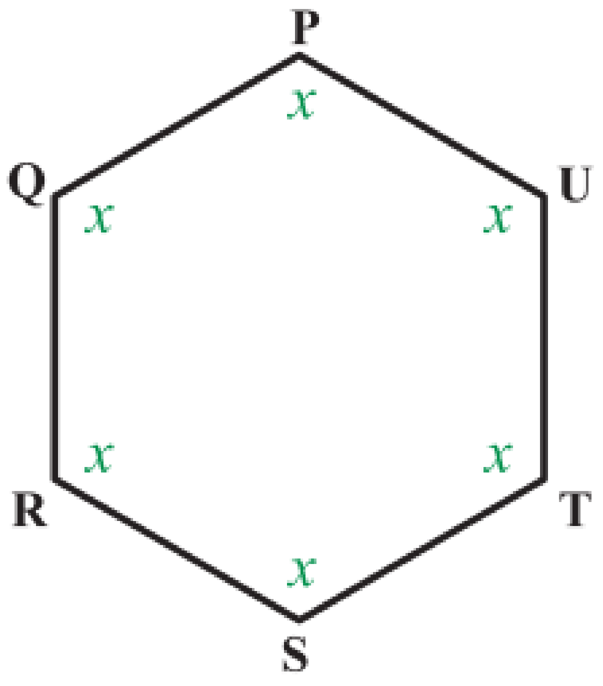
$\therefore x + 97° + 97° + x - 7° + x - 7° = 180°(5-2)$

$\therefore 3x + 180° = 180°(3)$ → take the 180° to the RHS

$\therefore 3x = 360°$ → divide both sides by 3

$\therefore x = 120°$

Example 2: Determine the value of x in the diagram alongside if PQRSTU is a regular polygon:



Interior angle of a regular polygon $= \frac{180°}{n}(n-2)$

$\therefore x = \frac{180°}{6}(6-2)$

$\therefore x = 30°(4)$

$\therefore x = 120°$

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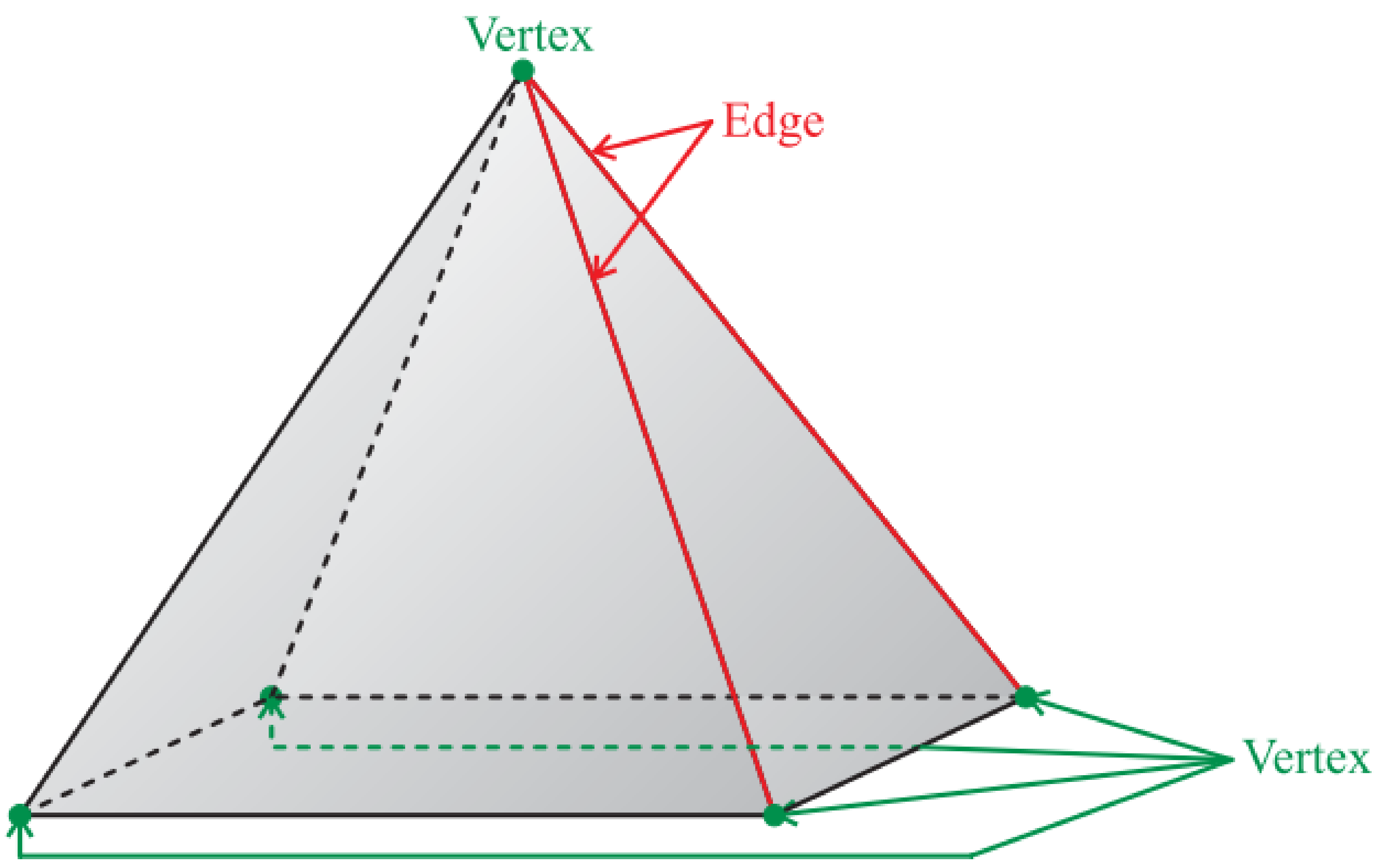
POLYHEDRONS

A **polyhedron is a three-dimensional** (3D) shape that is **bound by polygons**. **Each polygon** makes up the **sides (faces) of the polyhedron**. Where **two sides or faces meet** is called an **edge**. A **corner** of a polyhedron is called a **vertex**.
A **vertex** is where **3 or more sides meet.**
A common polyhedron, called a pyramid, is shown below. A pyramid is a 3D solid that has a base which is a polygon and faces (sides) that are triangles. All of the faces meet at a common vertex.



A prism is a polyhedron with a pair of parallel congruent (identical) faces. These faces are often referred to as the bases of the prism. The remaining faces of the prism are all parallelograms.
The bases of a prism must be made up of polygons.

EULER'S LAW

In Grade 8 you were introduced to Euler's Law.
Euler's Law is a formula which **relates** the **number of faces F**, the **number of vertices V** and the **number of edges E**, in any polyhedron.

Euler's Formula:

$$F + V - E = 2$$

Where: $F \rightarrow$ **Number of Faces**
$V \rightarrow$ **Number of Vertices**
$E \rightarrow$ **Number of Edges**

Example: Is a shape with 30 edges, 12 vertices and 20 faces a polyhedron?

To determine if the shape is a polyhedron, apply Euler's Law.

$$\begin{aligned} F + V - E &= 20 + 12 - 30 \\ &= 2 \end{aligned}$$

As Euler's Law applies, the shape is a polyhedron.

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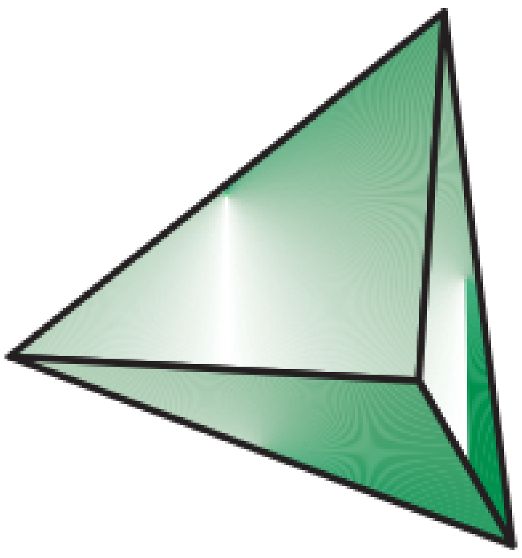
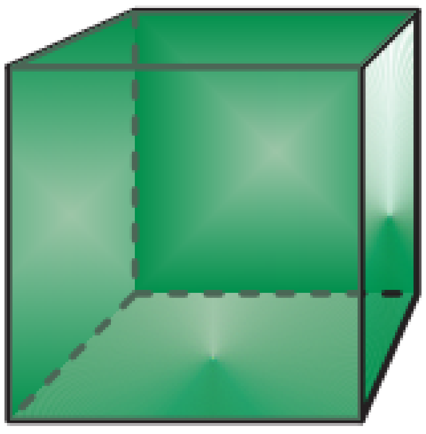
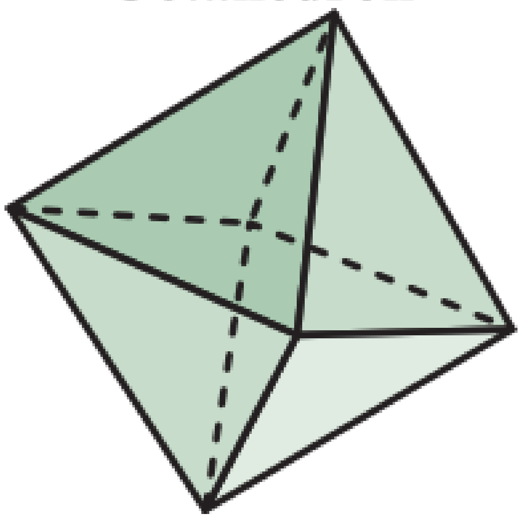
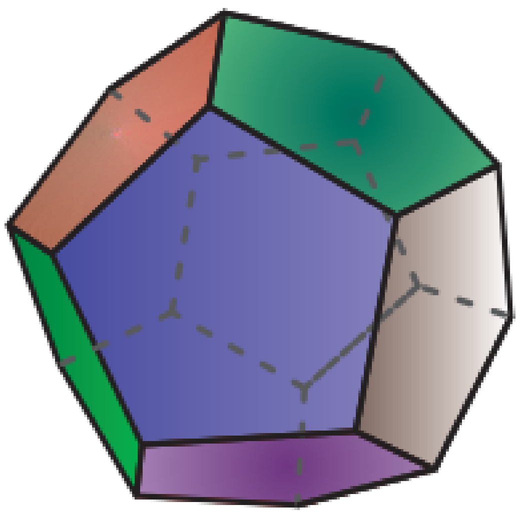
B. PLATONIC SOLIDS

A **platonic solid** is a polyhedron whose **faces are all regular and congruent** polygons.
Each vertex of a **platonic solid** always **points outwards**.
There are 5 possible platonic solids which are shown in the table below:

Platonic Solid	Properties
Tetrahedron 	• Made up of **4 equilateral triangles** • 3 triangles meet at each vertex • 4 faces • 4 vertices • 6 edges
Hexahedron (Cube) 	• Made up of **6 squares** • 3 squares meet at each vertex • 6 faces • 8 vertices • 12 edges
Octahedron 	• Made up of **8 equilateral triangles** • 4 triangles meet at each vertex • 8 faces • 6 vertices • 12 edges
Dodecahedron 	• Made up of **12 regular pentagons** • 3 pentagons meet at each vertex • 12 faces • 20 vertices • 30 edges
Icosahedron 	• Made up of **20 equilateral triangles** • 5 triangles meet at each vertex • 20 faces • 12 vertices • 30 edges

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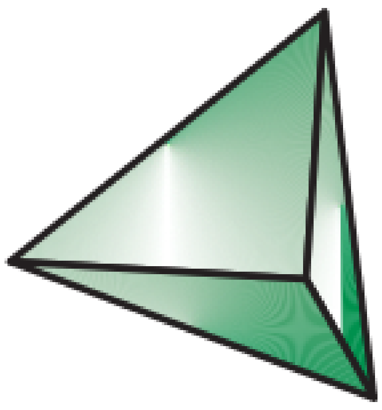
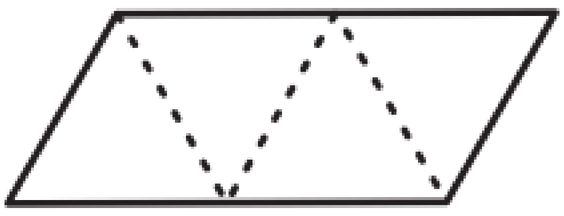
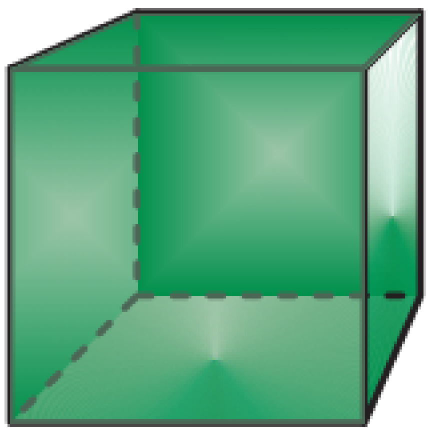
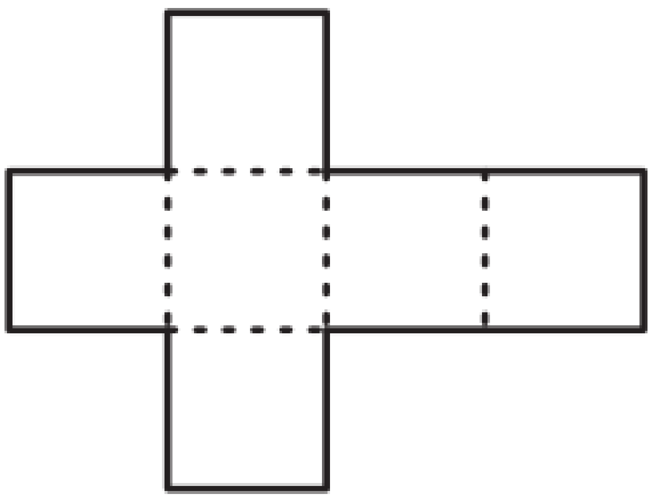
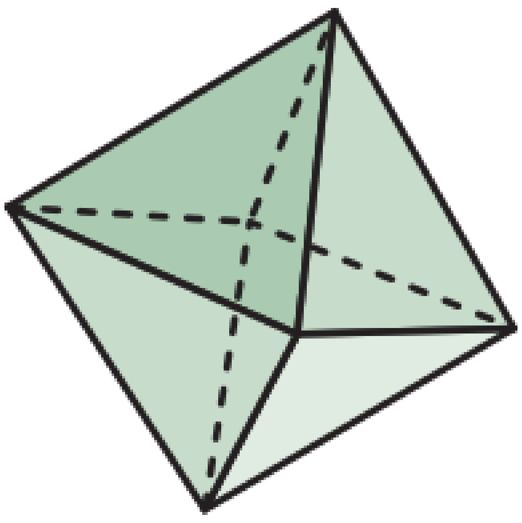
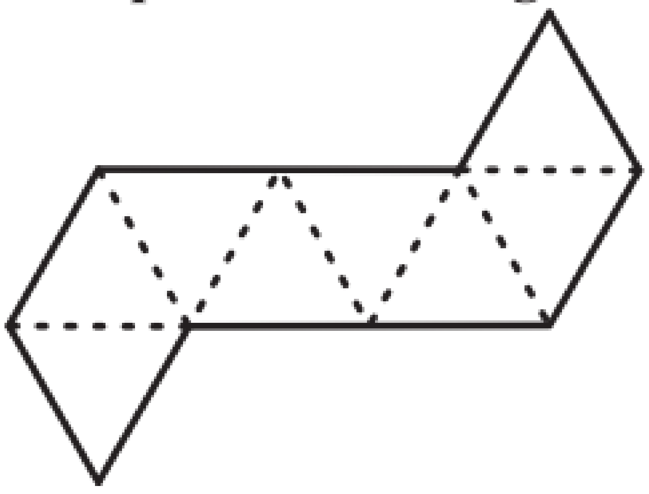
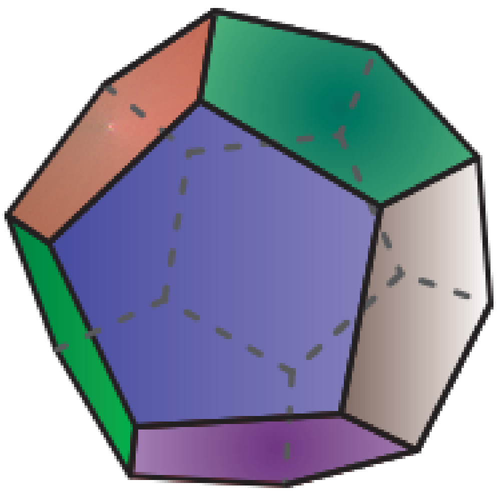
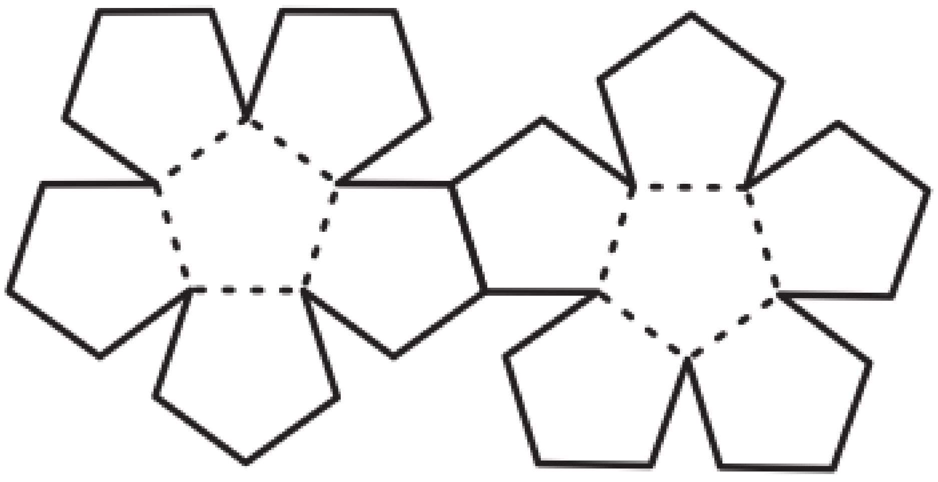
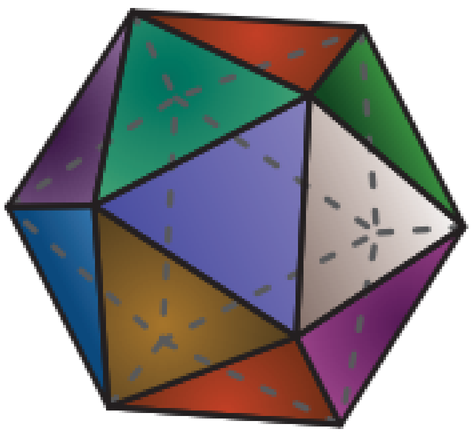
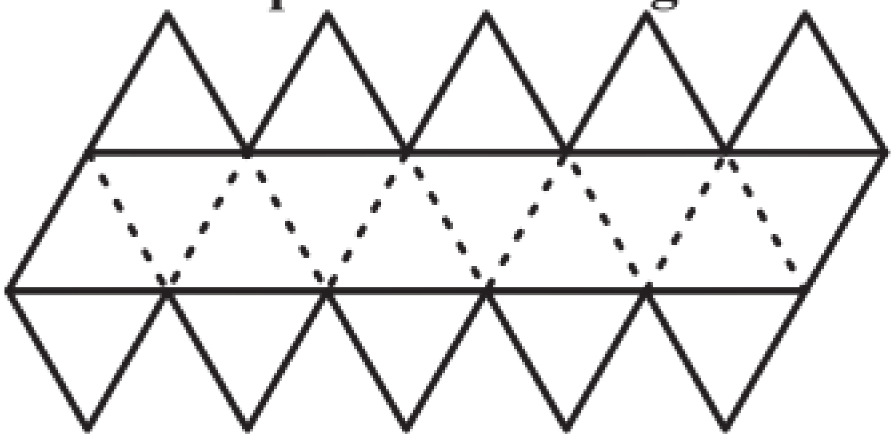
C. NETS OF SHAPES

A **net of a shape** is a **flat diagram of all** the **polygons that make up the shape**.
If a net of a shape is cut out it can be folded to form the shape. The nets of the five platonic solids are shown below.

Platonic Solid	Net
Tetrahedron 	**4 equilateral triangles** 
Hexahedron (Cube) 	**6 squares** 
Octahedron 	**8 equilateral triangles** 
Dodecahedron 	**12 regular pentagons** 
Icosahedron 	**20 equilateral triangles** 

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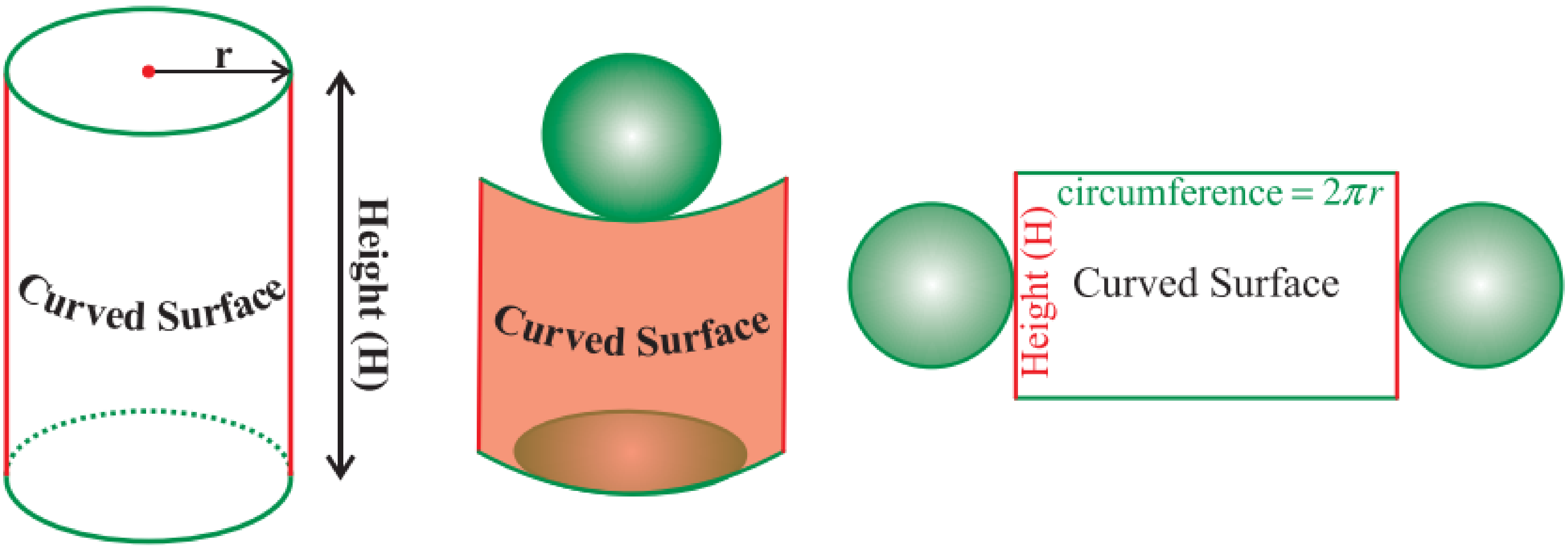
D. CYLINDERS AND SPHERES

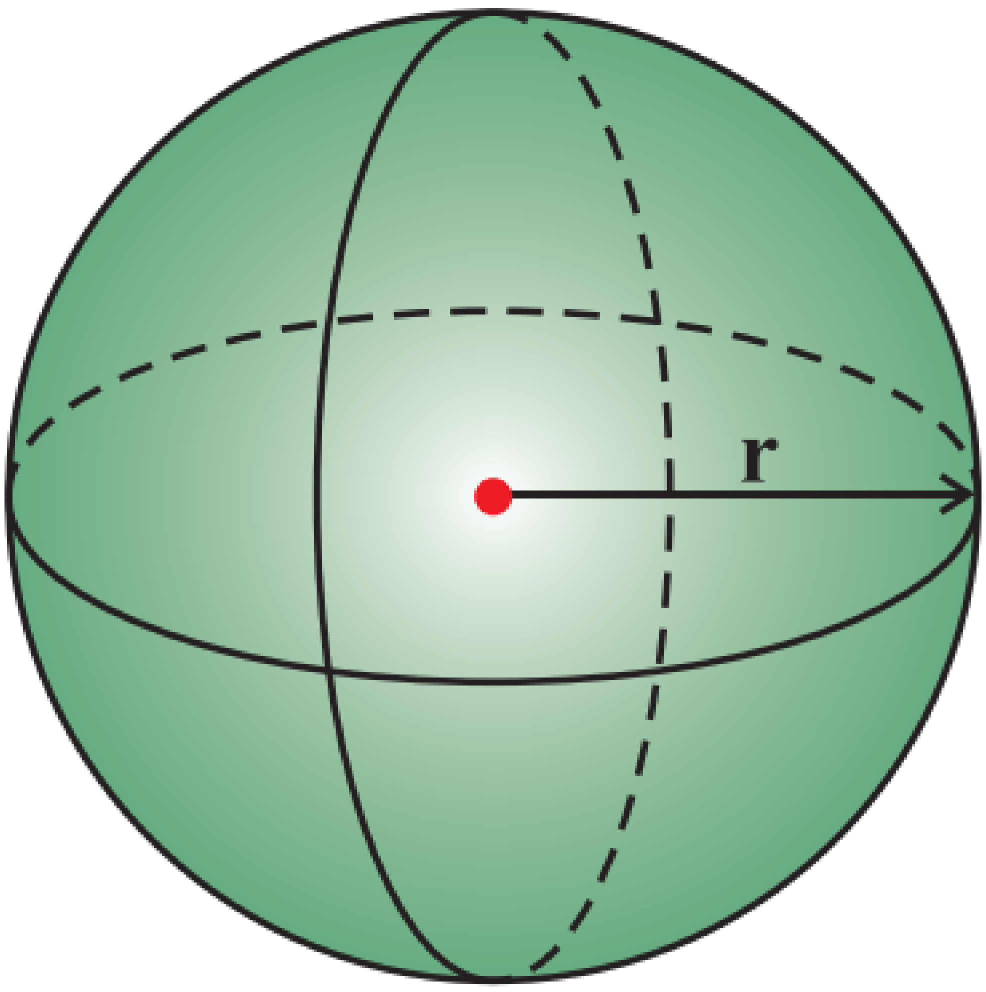
CYLINDERS

In Chapter 17 you were introduced to cylinders. A **cylinder** is a solid which has **two circles** that make up shapes base and a **curved surface**.
Note that although a cylinder has two congruent parallel bases it is not considered a prism as the bases are not polygons, they are circles.
A cylinder and its net is shown below.



SPHERES

A **sphere** is a **perfectly round ball** where every point on the sphere is an equal distance from the centre of the sphere. The **radius** of the sphere is the **distance from the centre** to a point on the surface of the sphere.



Complete the Mixed Exercise on pages 377 – 379.

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TERM 2
2024
GRADE 12

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Democracy and Human Rights

Question 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.

1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)

Question 1 : Explained Answers By CAPS AI

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ⓘ Below are **Question 1** explained answers by **CAPS AI** (supervised by Life Orientation Teachers)

1.1.1

A. eliminate unfair discrimination and promote equal opportunities for all.

Explanation: The **Labour Relations Act (LRA)** in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the **Employment Equity Act** and the **Skills Development Act** rather than the core purpose of the LRA.

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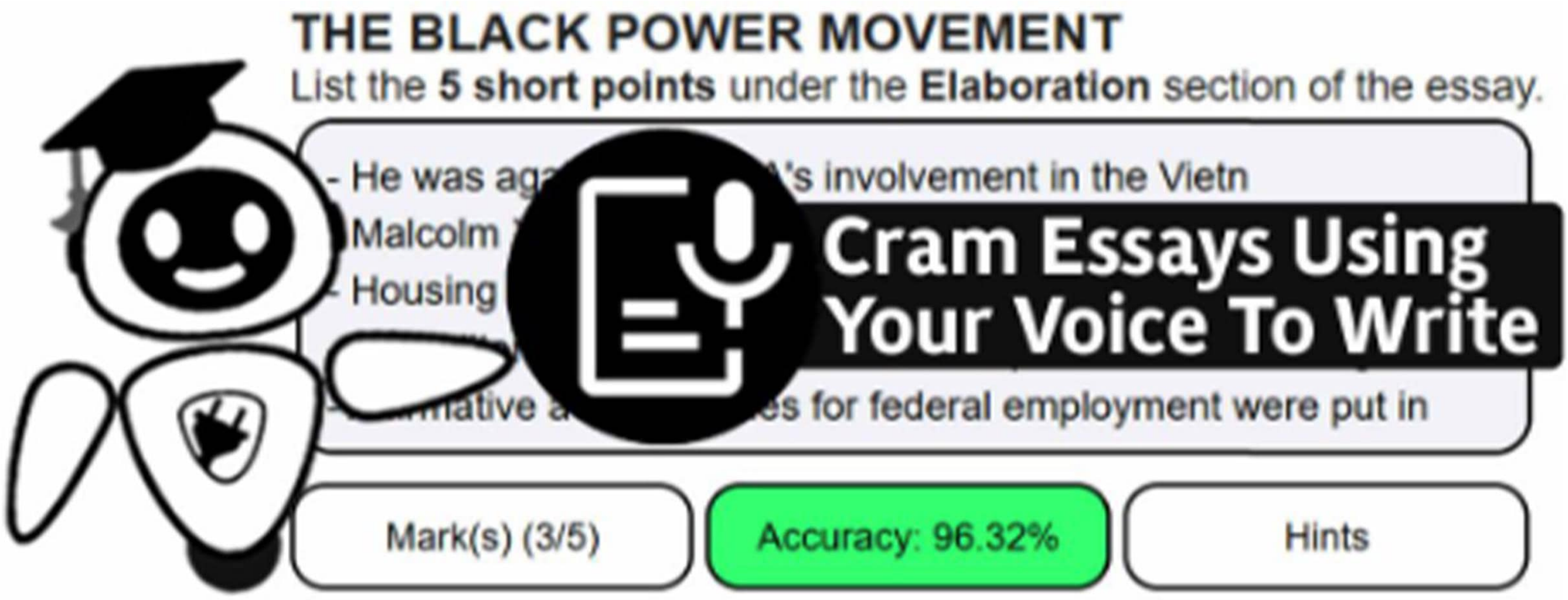

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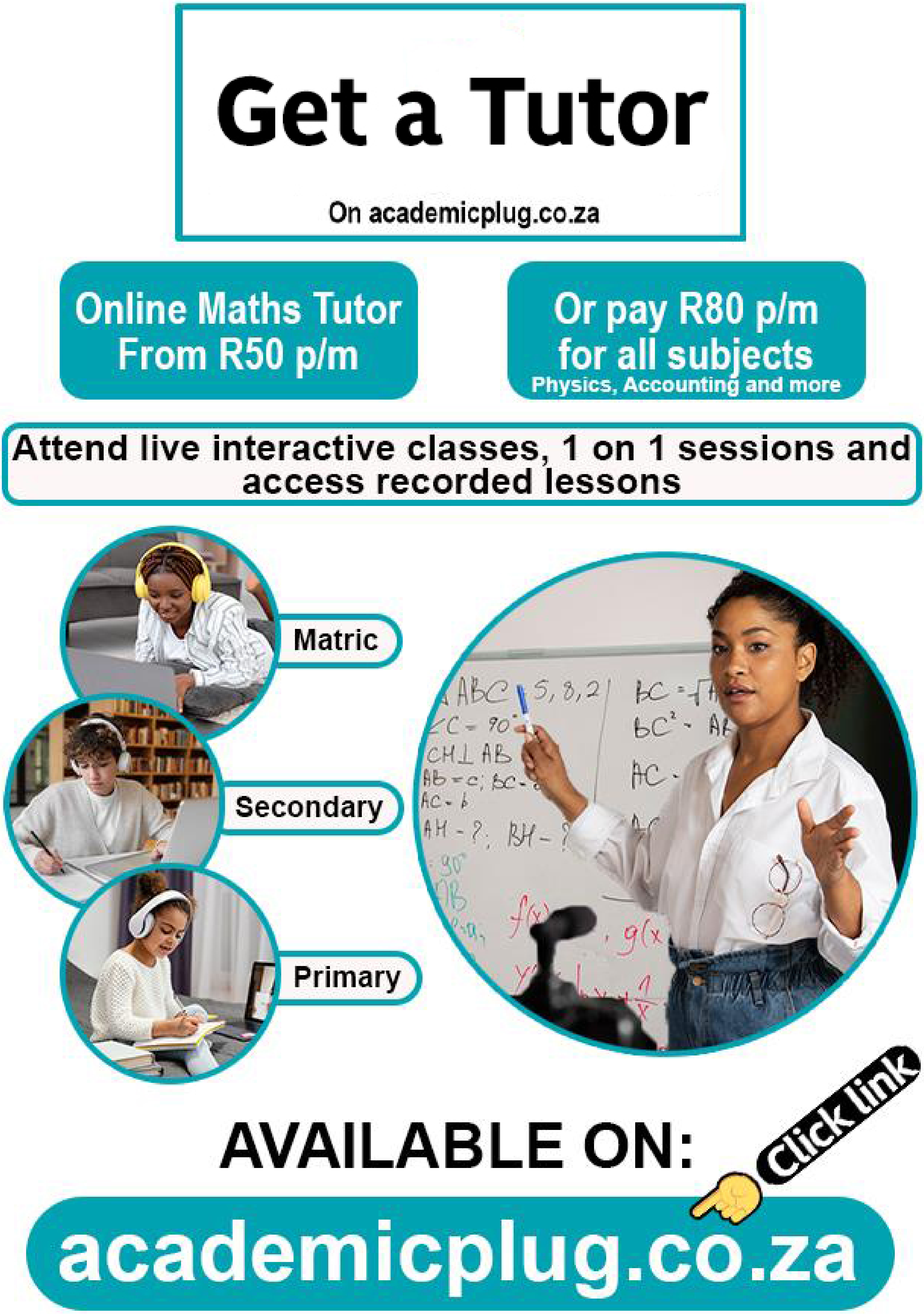

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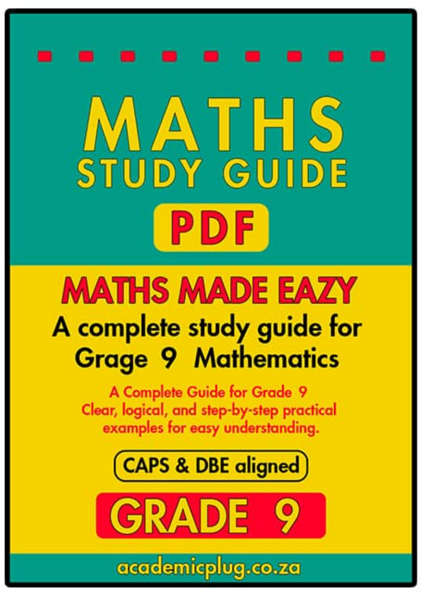

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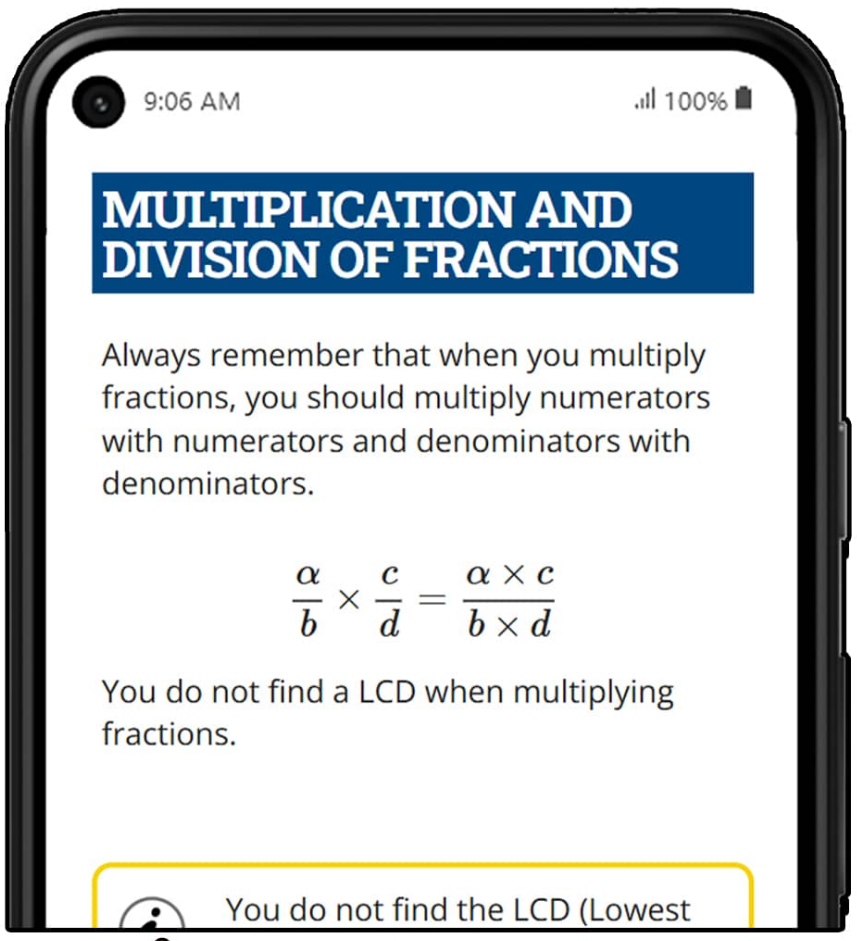

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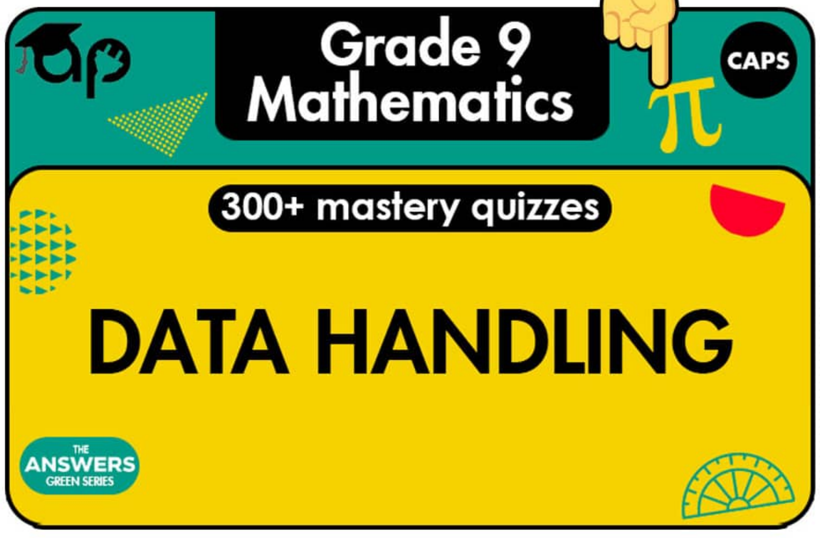

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CHAPTER 20
DATA HANDLING

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
208	**A. Revision of Organisation and Representation of Data**	5.1	• Select and justify appropriate methods for collecting data
208	• Frequency Tables	5.2	• Organize numerical data to summarize by determining measures of central tendency and dispersion including extremes and outliers
209	• Stem and Leaf Plots	5.3	• Organize data according to more than one criteria
210	• Histograms and Grouped Data		• Draw a variety of graphs to display and interpret data including bar graphs, double bar graphs, histograms, pie charts, broken-line graphs and scatter plots
211	• Bar Graphs and Pie Charts		• Interpret data represented in a variety of ways
213	• Broken Line Graphs		• Critically compare two sets of data and analyse data by answering questions related to data collection methods, summary statistics of data and sources of error and bias in the data
214	**B. Scatter Plots**		• Summarize data in short paragraphs that include drawing conclusions about the data, making predictions based on the data, making comparisons between two sets of data, identifying sources of error and bias in the data, choosing appropriate summary statistics for the data (mean, median, mode, range) and the role of extremes and outliers in the data
214	• Trends Between Two Variables		
215	• Outliers		
216	• Line of Best Fit		
217	**C. Measures of Central Tendency**		
217	• Mean		
217	• Median		
219	• Mode		
220	• Grouped Data		
221	**D. Measures of Dispersion**		
221	• Range		
222	• Quartiles		
224	• Inter-Quartile Range		
225	**The Data Cycle**		
225	• Statistical Problem		
225	• Collect, Organise and Summarise Data		
226	• Represent Data		
226	• Analyse, Interpret and Report		

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A. REVISION OF ORGANISATION AND REPRESENTATION OF DATA

When a **survey or research** is performed, **information called data is collected**. Without a meaningful way of representing this information, the data would be useless. This section deals with different ways of **collecting**, **organising**, **representing** and **interpreting numerical data**.

FREQUENCY TABLES

The **number of times a particular data value occurs** is known as the **frequency.** A frequency table is used to organise data and determine the number of times a particular data value occurs or the number of times data values in a certain range occurs.

Example 1: A local restaurant asks 40 of its customers to rate the service they received from 1 to 5, where 1 is the worst service they could have received and 5 is the best. The Table below shows the results of the survey for an evening dinner service. Construct a tally and frequency table for the data below.

5	2	4	5	2	3	3	3	1	2
4	4	5	2	1	2	2	4	4	1
4	5	5	5	3	1	4	5	5	3
4	3	4	3	5	3	4	3	3	4

Rating	Tally	Frequency
1	||||	4
2	𝍸 |	6
3	𝍸 𝍸	10
4	𝍸 𝍸 |	11
5	𝍸 ||||	9

The tally column is a way of counting the number of times a value occurs in a data set. A tally mark (𝍸) is made for every five occurrences of a particular value.

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Example 2: **The table below shows the percentages that two Grade 9 mathematics classes obtained in a test. Construct a frequency table for the data below**

62	52	65	58	63	59	68	41	67	72
71	82	73	66	74	64	77	62	79	61
81	66	85	63	91	66	87	69	88	68
94	77	93	75	50	74	51	69	53	52
54	60	44	62	38	66	32	63	20	69

The marks vary from 20% to 94%. It would be impractical to write down every mark from 20% to 94% in the frequency table. In this case, you can split the range of marks into intervals.

As a rule, a frequency table should contain between five and 10 intervals. When data is grouped into intervals it is known as grouped data.

Percentage	Frequency
20 – 29	1
30 – 39	2
40 – 49	2
50 – 59	8
60 – 69	20
70 - 79	9
80 – 89	5
90 – 99	3

STEM AND LEAF PLOTS

In a stem and leaf plot, the values of the data are split into a stem and leaf (or leaves in back to back stem and leaf plots). The **stem** contains the **primary digits** of the values in the data, whilst the **leaves** contain the **secondary digit**. For example, the number **246** would be split into the **stem** and **leaf** as follows:

Stem → 24

Leaf → 6

Example 1: **Construct a stem and leaf plot from the following marks that fifteen Grade 9 learners obtained in a Mathematics test out of 100 marks.**

73	75	76	80	83	83	87	88	90	90	94	96	99	99	100

Construct a stem and leaf plot for the data in the table above.

Stem	Leaf
7	3 5 6
8	0 3 3 7 8
9	0 0 4 6 9 9
10	0
Key: 7|3 means a mark of 73	

You must include a key to indicate the meaning of the stem and leaf numbers. Always arrange the leaves in order from smallest to largest from the stem.

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Example 2: Construct a back to back stem and leaf plot from the following two sets of data:

Data Set A:	12	13	18	22	27	31	45	47
Data Set B:	11	15	16	20	24	30	30	45

Leaf Data Set A	Stem	Leaf Data Set B
8 3 2	1	1 5 6
7 2	2	0 4
1	3	0 0
7 5	4	5
Key: 4|5 means the number 45		

When two sets of data are given, one central stem can be used with two separate leaves for each data set. This is known as a **back to back stem and leaf plot.**

HISTOGRAMS AND GROUPED DATA

A **histogram** is used with **continuous data**. **Continuous data** is data which **can take on any value**, such as temperature or a person's height.
Continuous data cannot be counted.
There are **no gaps** between the bars of a **histogram** which indicates that the data is continuous.

Example: The table below shows the time in minutes it took 30 Grade 9 learners to complete 5 laps around an athletics track.

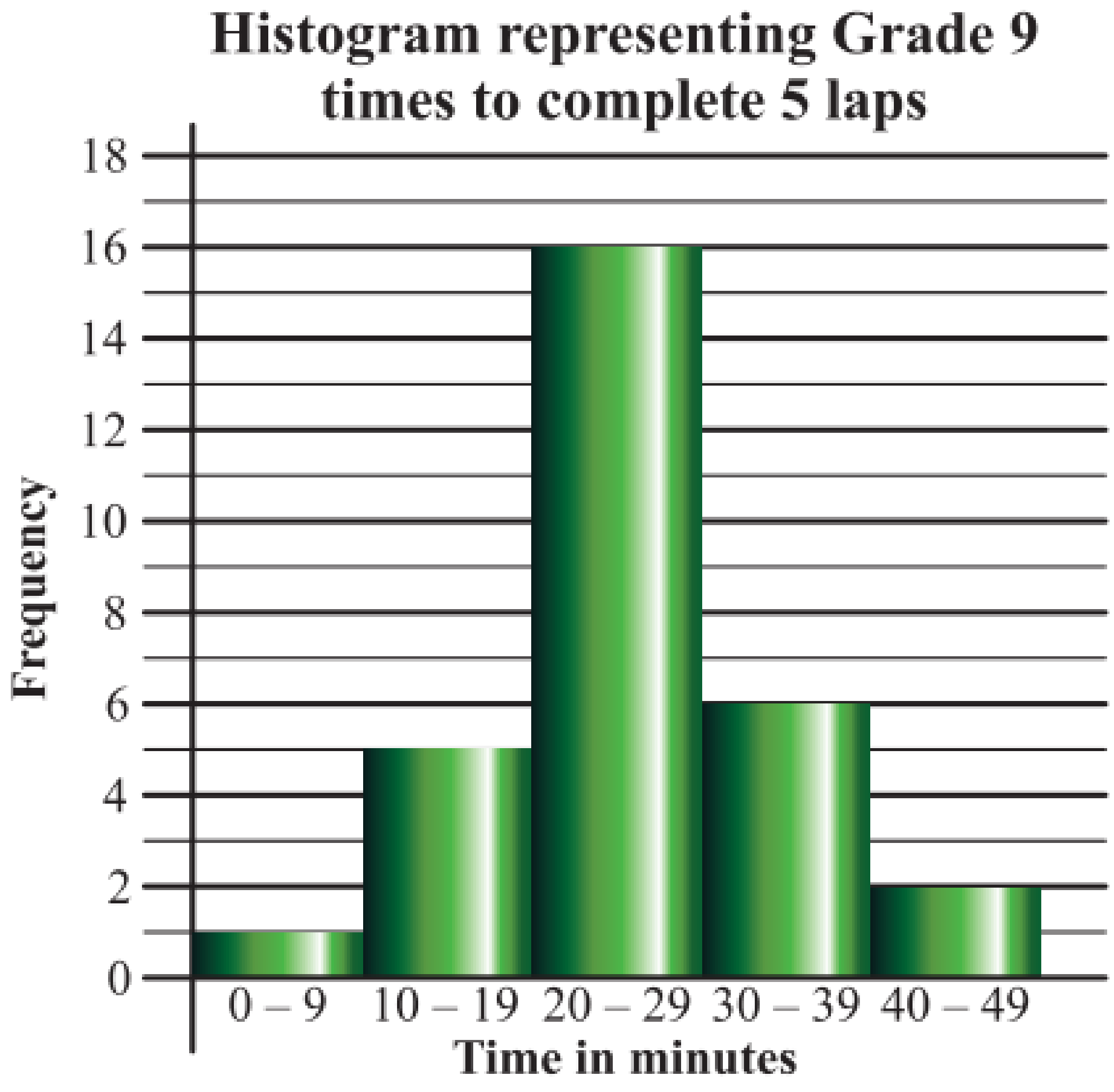
20	9	23	10	22	31	21	32	28	35
32	29	30	21	15	27	18	24	19	40
26	25	39	23	24	22	42	26	16	28

a) Draw a frequency table with suitable classes to represent the data in the table.
b) Draw a histogram to represent the data in your table.

a)

Time	Frequency
0 – 9	1
10 – 19	5
20 – 29	16
30 – 39	6
40 – 49	2

b)



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BAR GRAPHS AND PIE CHARTS

Bar graphs are used to represent **discrete data**.
Discrete data is data which **can be physically counted.**
As the data is discrete, the **bars** for each category **are separated** to show that they do not continue from one category to the next.
When drawing a **compound** (double) **bar graph** you must **add a key** to the graph.

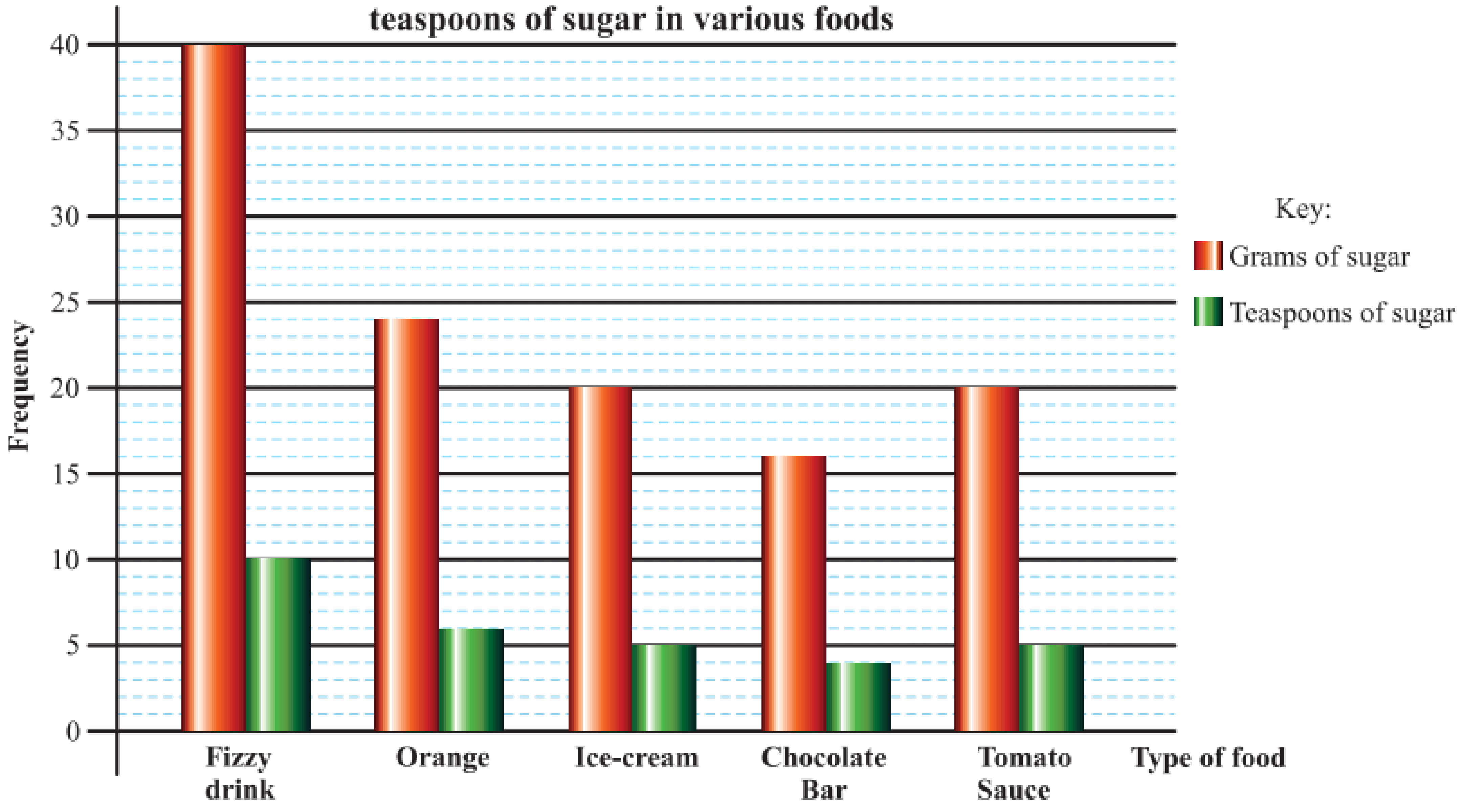
Example 1: The table below shows the amount of sugar and equivalent number of teaspoons in each type of food.

Type of food	Fizzy drink (1 can)	1 Large Orange	Ice-Cream (1 serving)	Chocolate bar	Tomato Sauce (5 tablespoons)
Amount of Sugar (g)	40	24	20	16	20
Number of Teaspoons	10	6	5	4	5

a) Draw a compound bar graph to graphically represent the information in the table.
b) Draw a pie chart to represent the number of teaspoons of sugar in each type of food. Show the percentage that each slice of the pie represents on your chart.

a)

Compound bar graph representing the number of grams and teaspoons of sugar in various foods



b) In order to draw a pie chart you need to calculate the total number of teaspoons of sugar in all the different types of foods:

$$\text{Total number of teaspoons} = 10 + 6 + 5 + 4 + 5$$
$$= 30$$

Using this information, you can now draw up and use the table shown on the next page to plot a pie chart.

To calculate the number of degrees that each food occupies, you use the formula shown below and note that there are 30 teaspoons in total:

Number of degrees per sector:

$$\frac{\textbf{number of values in sector}}{\textbf{total number of values}} \times 360^\circ = \textbf{number of degrees per sector}$$

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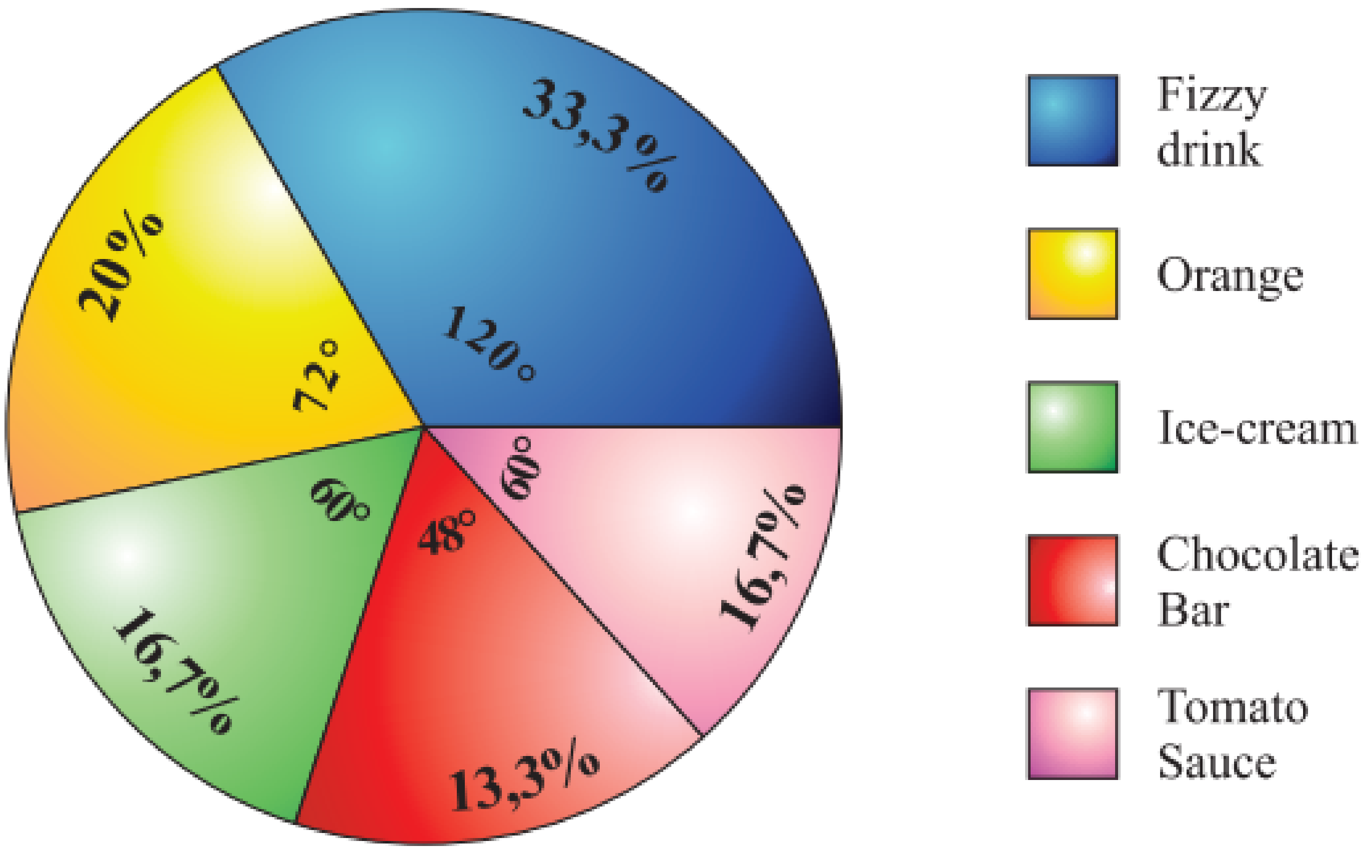
	Number of Teaspoons	Degrees in pie chart	Percentage of pie chart
Fizzy drink	10	$\frac{10}{30}\times 360^\circ = 120^\circ$	$\frac{10}{30}\times 100\% = 33,3\%$
Orange	6	$\frac{6}{30}\times 360^\circ = 72^\circ$	$\frac{6}{30}\times 100\% = 20\%$
Ice-cream	5	$\frac{5}{30}\times 360^\circ = 60^\circ$	$\frac{5}{30}\times 100\% = 16,7\%$
Chocolate Bar	4	$\frac{4}{30}\times 360^\circ = 48^\circ$	$\frac{4}{30}\times 100\% = 13,3\%$
Tomato Sauce	5	$\frac{5}{30}\times 360^\circ = 60^\circ$	$\frac{5}{30}\times 100\% = 16,7\%$



When plotting pie charts, make sure that the sum of all the degrees adds up to 360° and that the sum of percentages adds up 100%. You usually round off to one decimal place when drawing pie charts.

Example 2: **In a survey of 200 people, 30% of people selected that their favourite beverage was fizzy drinks. On a pie chart, Ice-cream's sector occupied 144°. How many people chose fizzy drinks and how many people chose ice-cream in the survey?**

$$\frac{\text{Number of people that chose fizzy drinks}}{200}\times 100\% = 30\% \rightarrow \text{divide both sides by } 100\%$$

$$\therefore \frac{\text{Number of people that chose fizzy drinks}}{200} = 0,3 \rightarrow \text{multiply both sides by } 200$$

$$\therefore \text{Number of people that chose fizzy drinks} = 60 \text{ people}$$

$$\frac{\text{Number of people that chose ice-cream}}{200}\times 360^\circ = 144^\circ \rightarrow \text{divide both sides by } 360^\circ$$

$$\therefore \frac{\text{Number of people that chose ice-cream}}{200} = 0,4 \rightarrow \text{multiply both sides by } 200$$

$$\therefore \text{Number of people that chose ice-cream} = 80 \text{ people}$$

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BROKEN LINE GRAPHS

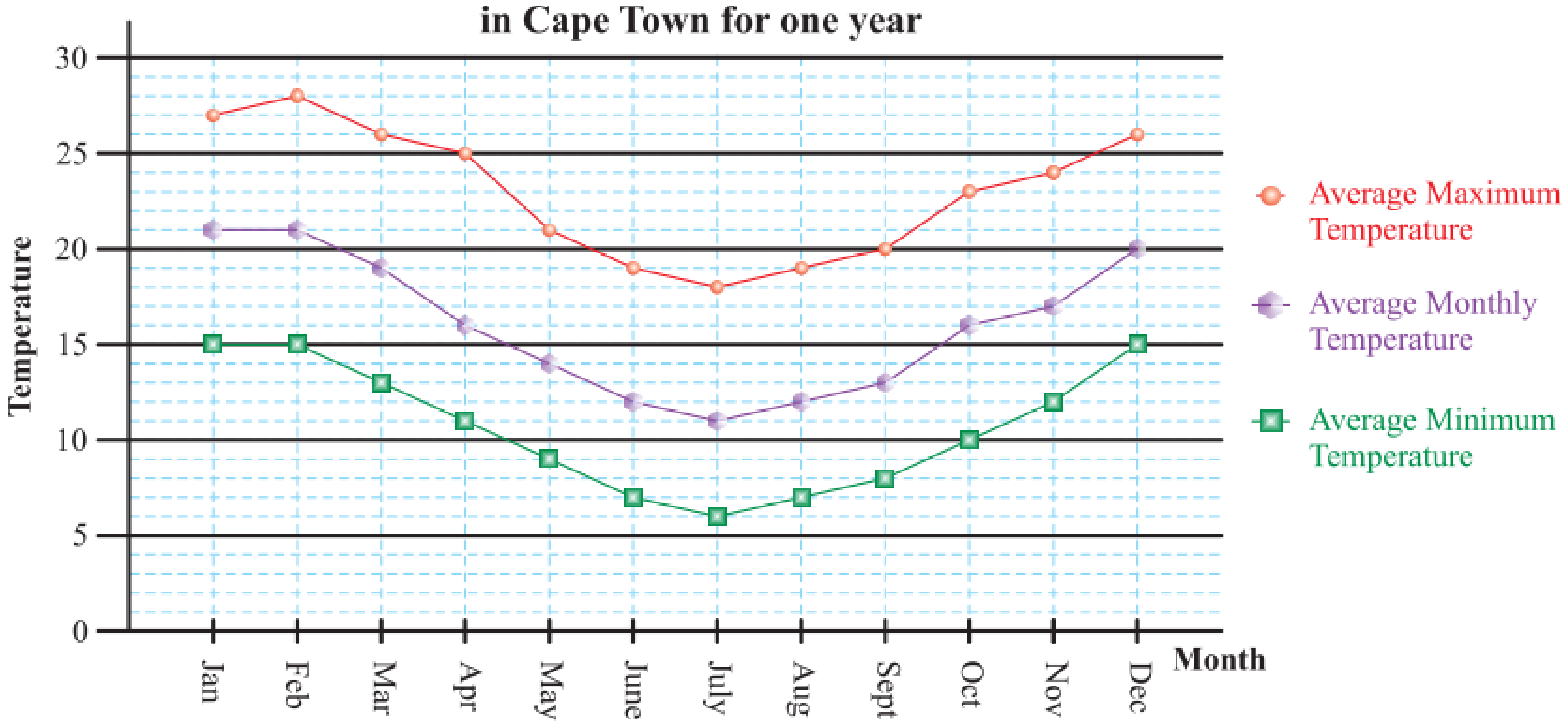
Broken line graphs are used to represent **data that changes continuously over time**. They are used to show and predict trends and patterns in data.

Example: The table below shows the average maximum and minimum temperatures as well as the average monthly temperature for a one year period in Cape Town.

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Avg. Max. Temp.	27	28	26	25	21	19	18	19	20	23	24	26
Avg. Min. Temp.	15	15	13	11	9	7	6	7	8	10	12	15
Avg. Temp.	21	21	19	16	14	12	11	12	13	16	17	20

a) Draw a broken line graph to represent the data in the table.
b) Use your graph to state the trend in temperatures from the months of February to July.

a) **Broken line graph representing average temperatures in Cape Town for one year**



When plotting broken line graphs with more than one type of data, you must place a key on the graph.

b) The average maximum, minimum and monthly temperatures all decrease from February to July.

Complete Exercise 1 on page 382.

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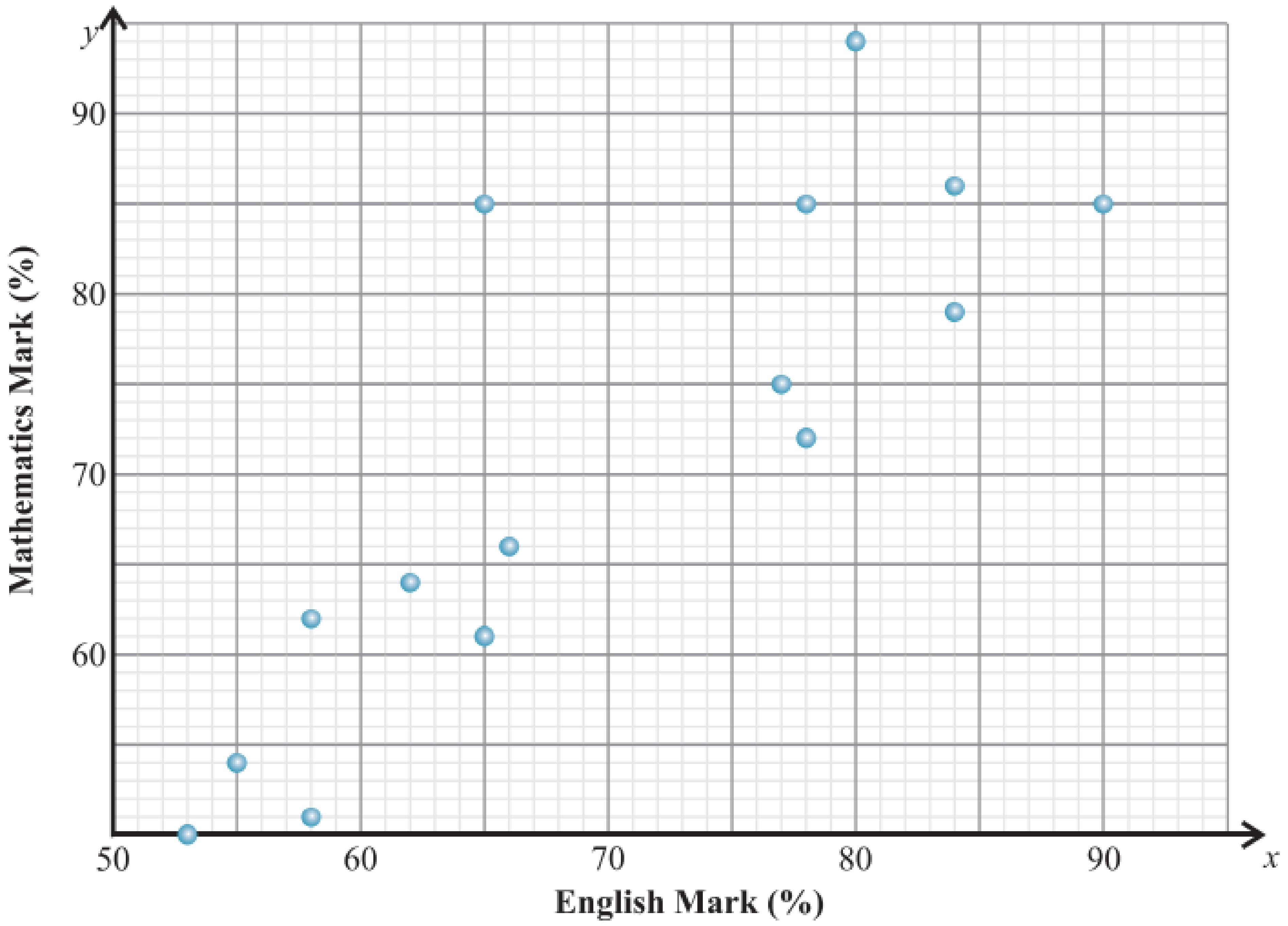
B. SCATTER PLOTS

Scatter Plots are used to represent **bivariate data**.
Bivariate data is data that has **2 variables**.
The **points** in a scatter plot are **never joined**.
A **scatter plot does not have to start at the origin** and the ***x* and *y*-axis do not have to have the same scale**.
Unless you are told which variable to plot on the *x* and *y*-axis, you can choose which variable to plot on each axis.

Example 1: The table below shows the percentages obtained by fifteen Grade 9 learners in a Mathematics and English test. Draw a scatter plot to represent the data in the table:

English (x)	58	84	84	66	78	65	62	55	58	78	90	80	77	53	65
Maths (y)	52	79	86	66	72	61	64	54	62	85	85	94	75	50	85



TRENDS BETWEEN TWO VARIABLES

A **scatter plot shows if there is a relationship** between the data and the **type of relationship** (if there is one). The table on the next page shows different types of trends that data can follow in Grade 9. **The trends between variables** is also **known as** the **correlation between the variables**.

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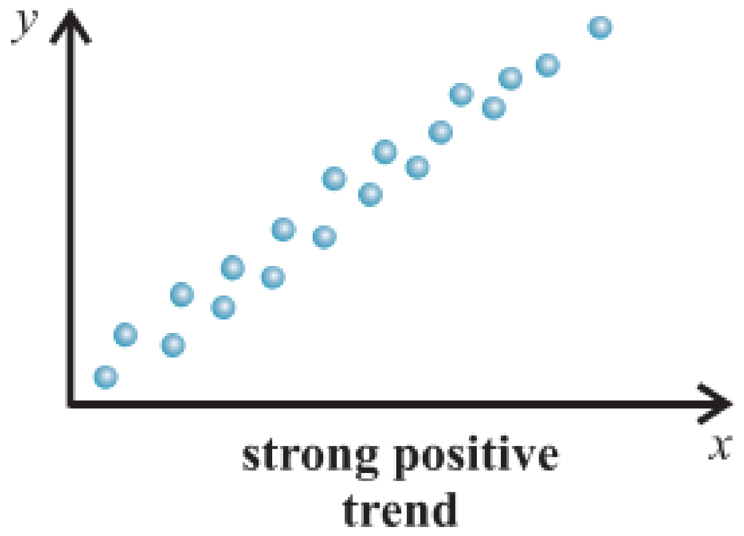
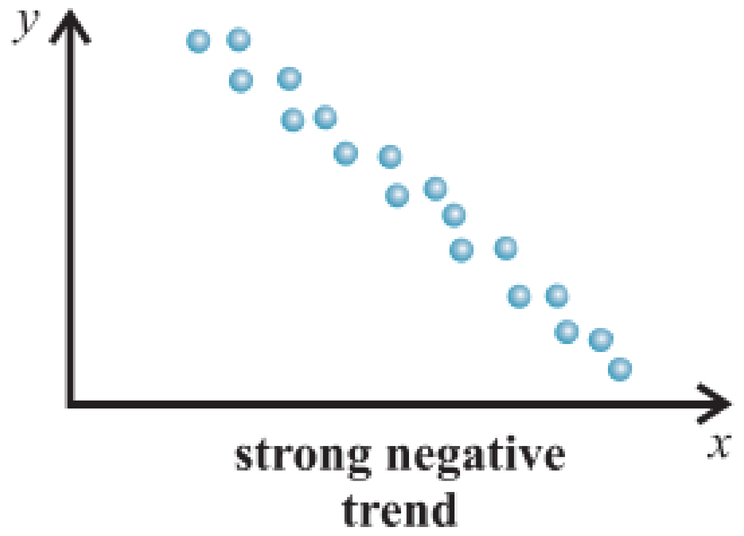
Strong Positive Trend (correlation)



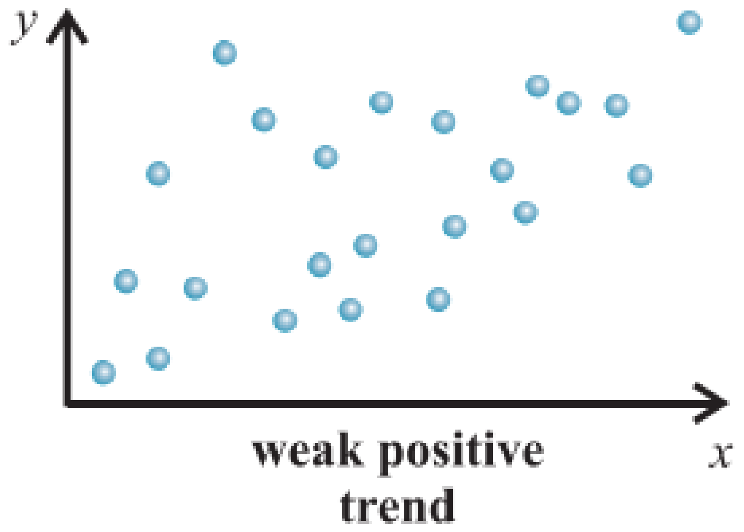
A positive trend occurs when the variable on the *y*-axis increases as the variable on the *x*-axis increases. The trend is **strong** because the points lie close to each other and are not scattered amongst the graph.

Strong Negative Trend (correlation)



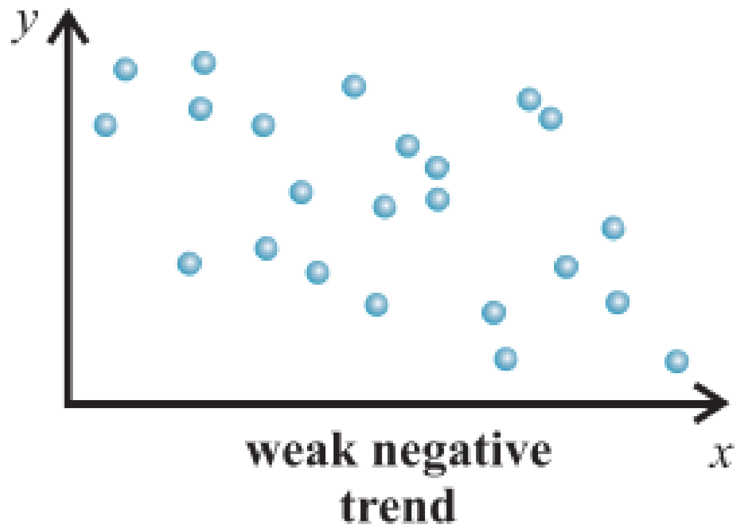
A negative trend occurs when the variable on the *y*-axis decreases as the variable on the *x*-axis increases. The trend is **strong** because the points lie close to each other and are not scattered amongst the graph.

Weak Positive Trend (correlation)



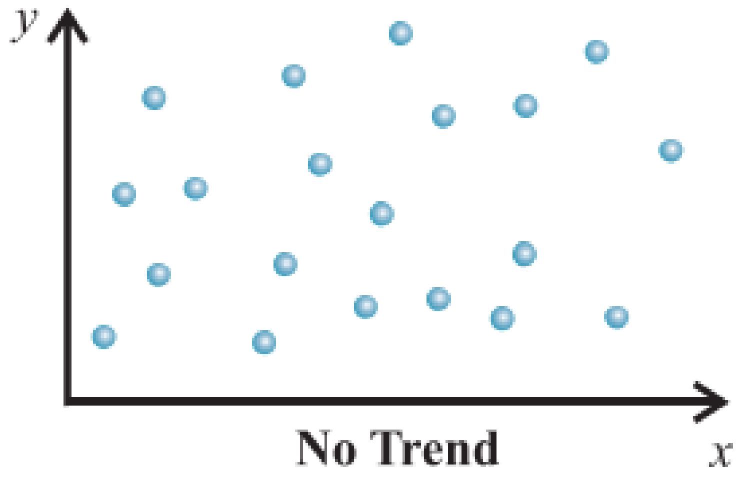
The trend is positive because the variable on the *y*-axis increases as the variable on the *x*-axis increases. The trend is **weak** because the points are not close to each other and are scattered amongst the graph.

Weak Negative Trend (correlation)



The trend is negative because the variable on the *y*-axis decreases as the variable on the *x*-axis increases. The trend is **weak** because the points are not close to each other and are scattered amongst the graph.

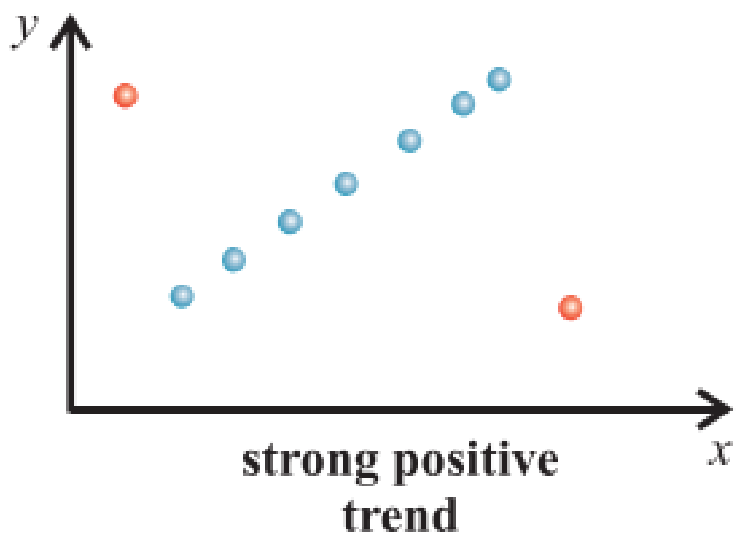
No Trend (correlation)



No trend can be seen in the above graph as the points are scattered all around the graph.

OUTLIERS

An **outlier** is a data point which **does not follow the trend of the data**. These are **usually** values which are **much smaller or larger than other values in the data set**.
The red points on the scatter plot below are outliers as they do not follow the trend of the data.



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LINE OF BEST FIT

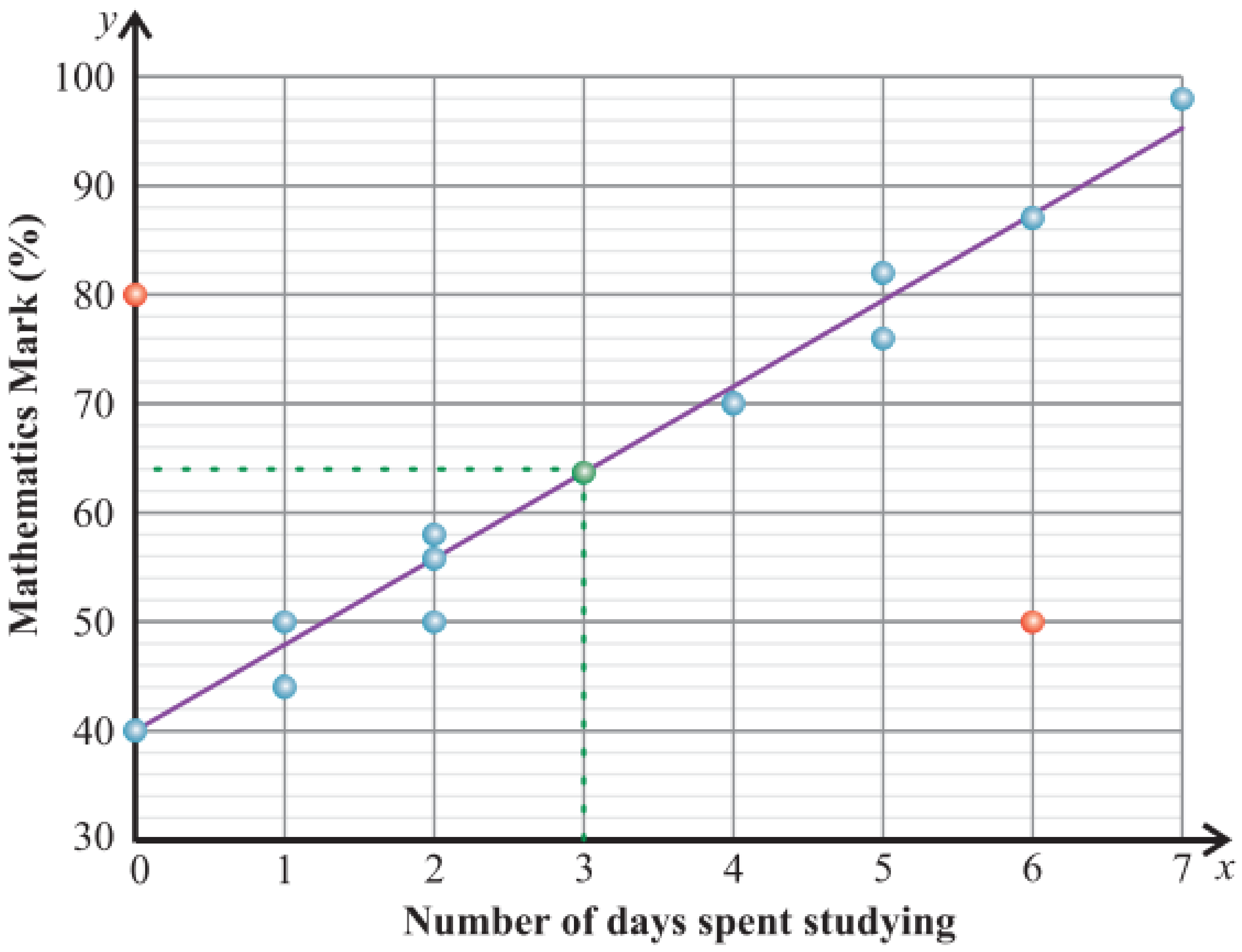
The **line of best fit** is drawn so that it **passes through as many points as possible** with an **equal number of points above and below the line** of best fit.
A line of best fit can be used to predict results not included in a data set.
A line of best fit is also called a regression line.

Example: **The table below shows the percentages obtained by thirteen Grade 9 learners in a Mathematics test and the number of days before the test they started studying. Draw a scatter plot to represent the data in the table:**

Days (x)	0	0	1	1	2	2	2	4	5	5	6	6	7
Mark (y)	40	80	44	50	50	56	58	70	76	82	50	87	98

a) **Draw a scatter plot to represent the data in the table.**
b) **Describe the trend in the data as positive or negative and weak or strong.**
c) **Draw a line of best fit on your scatter plot.**
d) **Are there any outliers in the data set? If so state the points which are outliers.**
e) **Use your line of best fit to predict the results of a learner that started studying 3 days before the test. Draw this point on the scatter plot.**

a)



b) The trend is positive and strong.
c) The line is drawn in **purple** on the above graph.
d) Outliers are shown in **red** on the above graph. These points are (0 ; 80) and (6 ; 50).
e) 64%. This point is drawn in **green** on the scatter plot. To predict the mark that a learner who studied for 3 days before the test would achieve, follow a vertical line up at 3 days on the x-axis until it reaches the line of best fit. The y-value at this point will be the predicted result of the learner.

Never join the points on a scatter plot. A line of best fit (regression line) is used on a scatter plot.

Complete Exercise 2 on pages 383 and 384.

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C. MEASURES OF CENTRAL TENDENCY

In Grade 8 you were introduced to three **measures of central tendency**. These were:

1. **Mean (average)**
2. **Median (middle value of a data set)**
3. **Mode (most frequent value in a data set)**

MEAN

The **mean** is the most frequently used measure of central tendency. It is commonly known as the **average**. **The mean** is the **sum of the data values** in the data set, **divided** by the **number of data values** in the data set. The **symbol** used for the **mean** is $\bar{x}$.

Mean ($\bar{x}$)

$$\bar{x} = \frac{\text{sum of the values in the data set}}{n}$$

Where: n is the number of values in the data set.

Example 1: **The table below shows the heights of a group of 10 Grade 9 learners in cm. What is the average height of the group?**

154	158	151	156	155	154	160	157	156	161

$$\text{mean} = \frac{154+158+151+156+155+154+160+157+156+161}{10} \rightarrow \frac{\text{sum of marks}}{n}$$

$$= 156,2\,\text{cm}$$

Example 2: **The table below shows the results obtained by two Grade 8 History classes in a test out of 100. Determine the mean (average) for each class.**

Data set A:

10	60	65	70	75	75	78	80	84	84	85	90

Data Set B:

60	60	65	70	75	75	78	80	84	84	85	90

Data set A :

$$\text{mean} = \frac{856}{12} \rightarrow \frac{\text{sum of Class 1 marks}}{n}$$

$$= 71,33$$

Data set B :

$$\text{mean} = \frac{906}{12} \rightarrow \frac{\text{sum of Class 2 marks}}{n}$$

$$= 75,5$$

The mean can be effected by outliers.
We say that outliers can skew the mean.
In the example 2 above, the outlier of 10 skewed the mean of data set A.

MEDIAN

The median is the middle value of an ordered data set. When determining the median of a data set the **data must always be ordered. The median divides a data set in half.**

The formula below is used to determine the position of the median:

$$\text{Position of median} = \frac{n+1}{2}$$

Where: n is the number of values in the data set.

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Example 1: **Determine the median of the data set below:**

1	**12**	**5**	**15**	**11**	**9**	**7**

Before determining the median, the data has to be written in order as shown below:

Position 1	Position 2	Position 3	**Position 4**	Position 5	Position 6	Position 7
1	5	7	**9**	11	12	15

You can now use the formula to determine the position of the median:

$$\text{Position of median} = \frac{n+1}{2}$$

$$= \frac{7+1}{2} \rightarrow \text{there are 7 elements in the data set}$$

$$= 4 \rightarrow \text{the } 4^{\text{th}} \text{ number in the data set is the median}$$

$\therefore \text{median} = 9$

Example 2: **Determine the median of the data set below:**

5	**11**	**9**	**7**	**3**	**15**	**9**	**5**

Before determining the median, the data has to be written in order as shown below:

Position 1	Position 2	Position 3	**Position 4**	**Position 5**	Position 6	Position 7	Position 8
3	5	5	**7**	**9**	9	11	15

You can now use the formula to determine the position of the median:

$$\text{Position of median} = \frac{n+1}{2}$$

$$= \frac{8+1}{2} \rightarrow \text{there are 8 elements in the data set}$$

$$= 4{,}5 \rightarrow \text{the median lies halfway between the } 4^{\text{th}} \text{ and } 5^{\text{th}} \text{ term}$$

In this case there are an even number of terms. This results in two terms being left in the middle. The median will lie half way between the two middle terms. Therefore, the median will be the sum of the middle terms divided by two:

$$\therefore \text{median} = \frac{7+9}{2} = 8$$

If there are an odd number of terms, the median will be the middle term in the ordered data set.

If there are an even number of terms, the median will lie halfway between the two middle terms in the ordered data set.

The median is not effected by outliers.

MODE

The **mode** of a data set is the **value that occurs most often**.
It is possible for there to be more than one mode or none at all.

Example: The table below shows the number of watch batteries sold at a local jewellery store over a two-week period.

Week 1:

Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Number of batteries	23	20	16	20	24	35	30

Week 2:

Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Number of batteries	24	21	15	24	24	31	29

a) Determine the mean (average) number of batteries sold per day at the store.
b) Determine the median of the data set.
c) Determine the mode of the data set.

a) $\text{mean} = \dfrac{23+20+16+20+24+35+30+24+21+15+24+24+31+29}{14}$

$= \dfrac{336}{14}$

$= 24 \text{ batteries per day}$

b) Before determining the median, you must order the data:

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Batteries	15	16	20	20	21	23	24	24	24	24	29	30	31	35

You can now use the formula to determine the position of the median:

$\text{Position of median} = \dfrac{n+1}{2}$

$= \dfrac{14+1}{2} \rightarrow$ there are 14 elements in the data set

$= 7{,}5 \rightarrow$ the median lies halfway between the 5th and 6th term

$\therefore \text{median} = \dfrac{24+24}{2} = 24 \text{ batteries}$

c) The mode is the value in the data set that occurs most often. In the above set of data, the value of 24 occurs most often.
$\therefore \text{Mode} = 24$ batteries

If there are two modes in the data set, the set is said to be bimodal.

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GROUPED DATA

Example: **The table and frequency table below are the heights of 30 Grade 9 learners.**

154	148	149	160	162
165	145	150	152	155
153	154	157	144	160
162	155	154	175	170
150	152	154	156	158
156	156	154	155	185

Table 1: Actual Heights

Height	Frequency
140 – 149	**4**
150 – 159	**18**
160 – 169	**5**
170 – 179	**2**
180 – 189	**1**

Table 2: Frequency Table of Grouped Data

a) Determine the mean height of the learners using the data in table 1.
b) Determine the estimated mean height of the learners using data in table 2.
c) What is the reason for the difference in your answers between *a* and *b* above?

a) $\text{mean} = \dfrac{4\,700}{30} \rightarrow \dfrac{\text{sum of table 1 heights}}{n}$

$= 156{,}67 \text{ cm}$

b) In a frequency table, you do not know the results of each individual person. In order to calculate the mean, we assume that every person in each interval obtained the midpoint value of the interval. To calculate the mean, draw the table shown below:

Height	Frequency f	Midpoint x	Frequency × Midpoint $f \times x$
140 – 149	**4**	$\dfrac{140+149}{2} = 144{,}5$	$4 \times 144{,}5 = \mathbf{578}$
150 – 159	**18**	$\dfrac{150+159}{2} = 154{,}5$	$18 \times 154{,}5 = \mathbf{2781}$
160 – 169	**5**	$\dfrac{160+169}{2} = 164{,}5$	$5 \times 164{,}5 = \mathbf{822{,}5}$
170 – 179	**2**	$\dfrac{170+179}{2} = 174{,}5$	$2 \times 174{,}5 = \mathbf{349}$
180 – 189	**1**	$\dfrac{180+189}{2} = 184{,}5$	$1 \times 184{,}5 = \mathbf{184{,}5}$
Total frequency:	$n = 30$		Sum of $f \times x = 4\,715$

In the above table, it is assumed that all learners in the interval from 140 – 149 had a height of 144,5 cm. You continue to assume that all 18 people in the interval 150 – 159 had a height of 154,5cm and so on. The sum of all heights is calculated by adding the $f \times x$ column. The total number of people is calculated by adding up the frequency column.

$\text{Estimated mean} = \dfrac{4\,715}{30} \rightarrow \dfrac{\text{sum of total assumed heights}}{n}$

$= 157{,}17 \text{ cm}$

c) When calculating the mean from table 1 you are using the exact height of each person. When using the frequency table to calculate the mean, you are using estimate values for each person's height. This is not as completely accurate but is more practical when analysing large sets of data.

When calculating the mean from grouped data it is called the estimated mean as the data used for each person is an estimate.

Complete Exercise 3 on page 384.

D. MEASURES OF DISPERSION

Measures of dispersion indicate how data is spread.
In Grade 9 there are 5 measures of dispersion:

1) **Range**
2) **Lower Quartile (Q_1)**
3) **Median (Q_2)**
4) **Upper Quartile (Q_3)**
5) **Interquartile Range (IQR)**

RANGE

The **range** of a data set is the **difference between** the **highest value and lowest value** in a data set.

Range:

Range = Largest Value – Smallest Value

Example: Two sets of data are shown in the table below.
a) Determine the range of each data set.
b) Identify any outliers in each set of data.
c) Determine the range of each set of data, leaving out any outliers identified above.

Data Set A	**16**	**61**	**65**	**67**	**75**	**60**	**64**	**62**	**76**	**75**	**79**	**68**
Data Set B	**60**	**63**	**64**	**65**	**76**	**79**	**68**	**73**	**66**	**65**	**74**	**72**

a)
$\text{Range}_{\text{Set A}} = 79 - 16 = 63$

$\text{Range}_{\text{Set B}} = 79 - 60 = 19$

b) 16 is an outlier of data set A as it is much lower than any other value in the set. There are no outliers in data set B.

c)
$\text{Range}_{\text{Set A}} = 79 - 60 = 19 \rightarrow$ the outlier of 16 has been omitted

$\text{Range}_{\text{Set B}} = 79 - 60 = 19$

It can be seen from the above example that a single outlier (16) can cause the measure of spread to be misleading. The range does not consider the distribution of data between the largest and smallest values in the set.

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QUARTILES

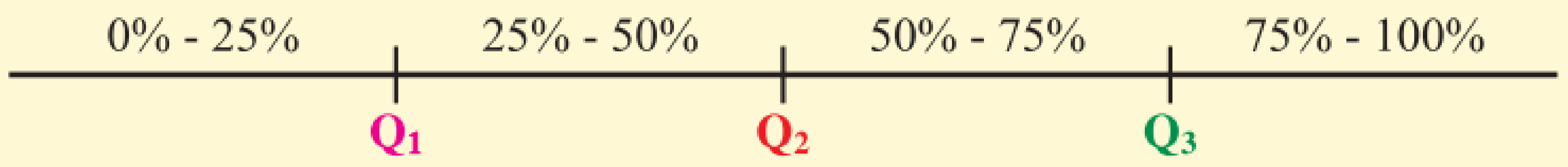
Quartiles divide a data set into quarters (four groups). The Quartiles provide an indication of the dispersion around the median and are especially useful in a data set which contains outliers. **The data must be ordered to determine the quartiles.**

There are three quartiles:

Lower Quartile (Q_1): The median of the lower half of the values in the data set

The Median (Q_2): The middle value of the data set (pg. 218)

Upper Quartile (Q_3): The median of the upper half of the values in the data set



STEPS TO CALCULATING QUARTILES

1. **Write the data in order and determine the median (Q_2).**
2. **Determine the lower quartile (Q_1) by finding the median of the lower half.**
3. **Determine the upper quartile (Q_3) by finding the median of the upper half.**

Example 1: The table below shows the times of the top 7 men in the 100m sprint final at the 2016 Olympics held in Rio. All times are in seconds. Determine the median, lower quartile and upper quartile times.

9,81	**9,89**	**10,04**	**9,96**	**9,91**	**9,93**	**9,94**

Step 1: Write the data in order and determine the median.

Lower Half				Upper Half		
Position 1	**Position 2**	Position 3	**Position 4**	Position 5	**Position 6**	Position 7
9,81	**9,89**	9,91	**9,93**	9,94	**9,96**	10,04

$$\text{Position of median} = \frac{n+1}{2}$$

$$= \frac{7+1}{2} \rightarrow \text{there are 7 elements in the data set}$$

$$= 4 \rightarrow \text{the median is the } 4^{\text{th}} \text{ term}$$

$$\therefore Q_2 = 9{,}93 \text{ seconds} \rightarrow \text{the median is } Q_2$$

Step 2 and 3: determine the lower and upper quartiles.
As the median is in position 4 there are 3 terms in the lower half and three terms in the upper half. The lower quartile is the median of the lower half and the upper quartile is the median of the upper half.

Position of Q_1 calculation	**Positions of Q_3 calculation**
Position of $Q_1 = \frac{n+1}{2}$ $= \frac{3+1}{2} \rightarrow$ 3 values in the lower half $= 2 \rightarrow Q_1$ is the 2nd term	Position of $Q_3 = 4 + \frac{n+1}{2}$ $= 4 + \frac{3+1}{2} \rightarrow$ 4 values before the upper half $= 6 \rightarrow Q_3$ is the 6th term

$$\therefore Q_1 = 9{,}89 \text{ seconds and } Q_2 = 9{,}93 \text{ seconds and } Q_3 = 9{,}96 \text{ seconds}$$

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Example 2: **The table below shows the countries and times of the final women's 100m backstroke at the 2016 Olympics held in Rio. All times are in seconds. Determine the median, lower quartile and upper quartile times. Give answers correct to 3 decimal places where necessary.**

58,75	**58,76**	**58,45**	**58,80**	**58,76**	**59,23**	**59,19**	**58,95**

Step 1: Write the data in order and determine the median.

				58,78				
Position	1	2	3	4	5	6	7	8
Term	58,45	58,75	58,76	58,76	58,80	58,95	59,19	59,23

Position of median $= \frac{n+1}{2}$

$= \frac{8+1}{2} \rightarrow$ there are 8 terms in the data set

$= 4,5 \rightarrow$ the median is half way between the 4th and 5th term

$\therefore Q_2 = \frac{58,76+58,80}{2} = 58,78$ seconds $\rightarrow$ the median is Q_2

Step 2 and 3: determine the lower and upper quartiles.

				58,78				
	Lower Half				**Upper Half**			
Position	1	**2**	**3**	4	5	**6**	**7**	8
Term	58,45	**58,75**	**58,76**	58,76	58,80	**58,95**	**59,19**	59,23

Position of $Q_1 = \frac{n+1}{2}$

$= \frac{4+1}{2} \rightarrow$ there are 4 terms in the lower half

$= 2,5 \rightarrow Q_1$ is half way between the 2nd and 3rd term

$\therefore Q_1 = \frac{58,75+58,76}{2} = 58,755$

Position of $Q_3 = 4 + \frac{n+1}{2} \rightarrow$ there are 4 terms before the upper half

$= 4 + \frac{4+1}{2} \rightarrow$ there are 4 terms in the upper half

$= 6,5 \rightarrow Q_3$ is half way between the 6th and 7th term

$\therefore Q_3 = \frac{58,95+59,19}{2} = 59,07$

$\therefore Q_1 = 58,755$ seconds and $Q_2 = 58,78$ seconds and $Q_3 = 59,07$ seconds

The quartiles show that:

- **A quarter (25%) of the times are below 58,755 seconds.**
- **Half (50%) of the times are below 58,78 seconds.**
- **Three quarters (75%) of the times are below 59,07 seconds.**

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INTER-QUARTILE RANGE

The Inter-Quartile Range (IQR) is the difference between the lower and upper quartiles. It is an indication of **how data is spread about the median**. It is **not affected by outliers** as it is based on the middle half of the data.
For this reason, it is a more accurate measure of dispersion than the range.

Inter-Quartile Range:

$$\text{IQR} = \text{Upper Quartile } (Q_3) - \text{Lower Quartile } (Q_1)$$

Example: The table below shows the percentages that 7 learners obtained in a class test. Determine the inter-quartile range for the data.

61	**64**	**69**	**73**	**75**	**74**	**66**

To determine the IQR you must first determine the upper and lower quartiles:

Step 1: Write the data in order and determine the median.

Lower Half				**Upper Half**		
Position 1	**Position 2**	Position 3	**Position 4**	Position 5	**Position 6**	Position 7
61	**64**	66	**69**	73	**74**	75

$$\text{Position of median} = \frac{n+1}{2} = \frac{7+1}{2} = 4$$

$$\therefore Q_2 = 69\%$$

Step 2 and 3: determine the lower and upper quartiles.

Position of Q_1 calculation	**Positions of Q_3 calculation**
Position of $Q_1 = \frac{n+1}{2}$ $= \frac{3+1}{2} \rightarrow$ 3 values in the lower half $= 2 \rightarrow Q_1$ is the 2nd term	Position of $Q_3 = 4 + \frac{n+1}{2}$ $= 4 + \frac{3+1}{2} \rightarrow$ 4 values before the upper half $= 6 \rightarrow Q_3$ is the 6th term

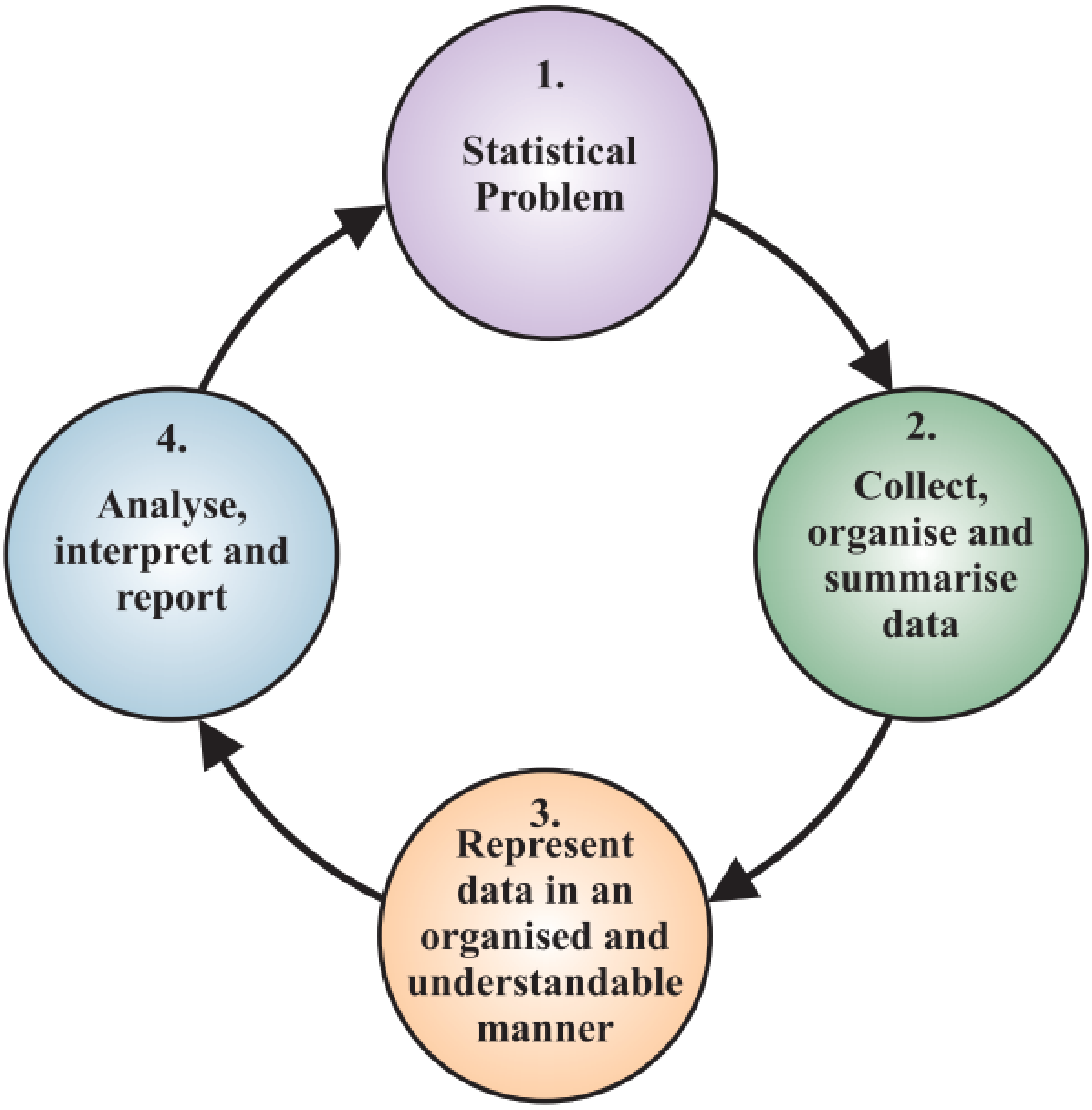
$\therefore Q_1 = 64\%$ and $Q_3 = 74\%$

$$\therefore \text{IQR} = Q_3 - Q_1 = 74 - 64$$
$$= 10\%$$

Complete Exercise 4 on page 385.

E. THE DATA CYCLE

You have now dealt with the 4 key stages of the Data Cycle.
These are represented in the diagram below.



1. STATISTICAL PROBLEM

- You are posed with a problem to be analysed.
- An example of a statistical problem could be:
  Has the rate of drunk driving increased or decreased over the past 5 years?

2. COLLECT, ORGANISE AND SUMMARISE DATA

- Once a statistical problem has been posed, data needs to be collected, organised and summarised.
- Data can be collected in many ways.
- In a small collection process, every member of a group can be questioned through means of a survey or interview or physical counts.
- Most data collection processes take place on a large scale. In these cases, a sample is taken which is representative of the entire population.
- A random sample must be taken from the population. A random sample is one where every member of the population has an equal chance of being chosen.
- Once data has been collected it must be arranged and summarised. This is often done using frequency tables and tree diagrams.

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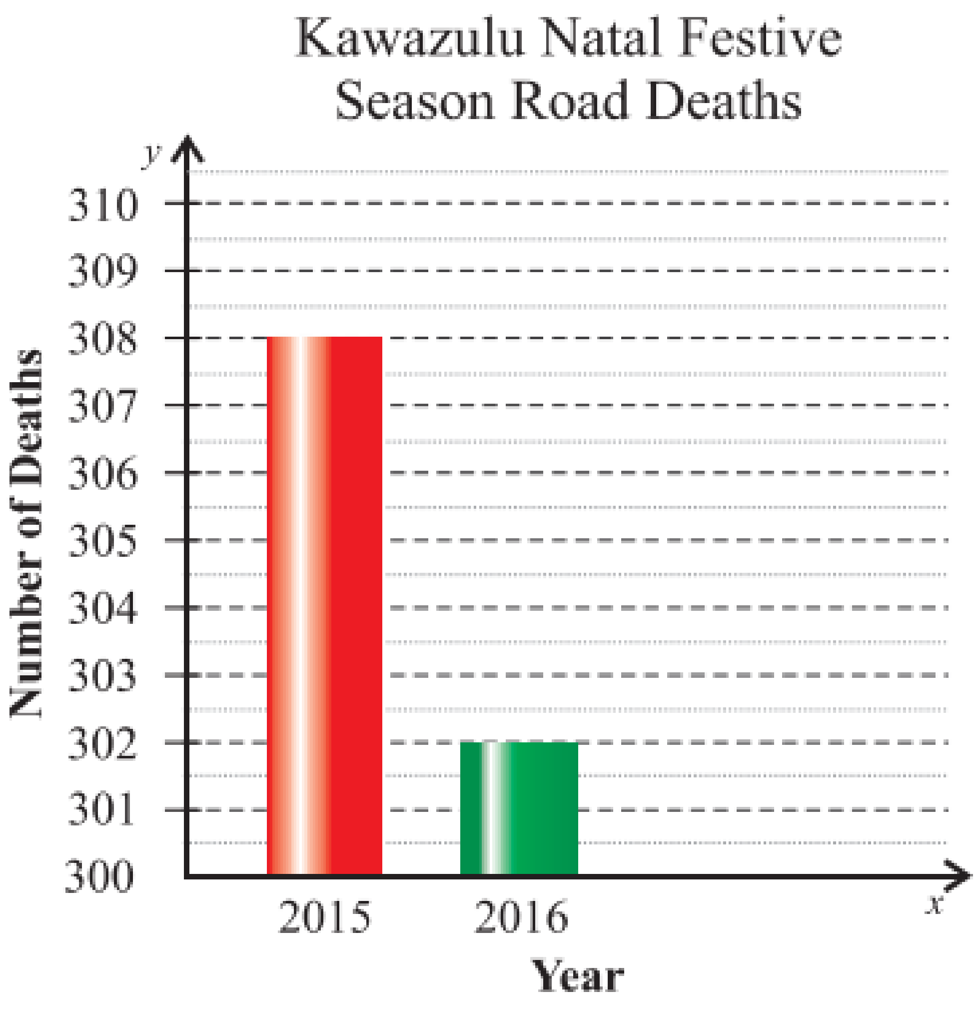
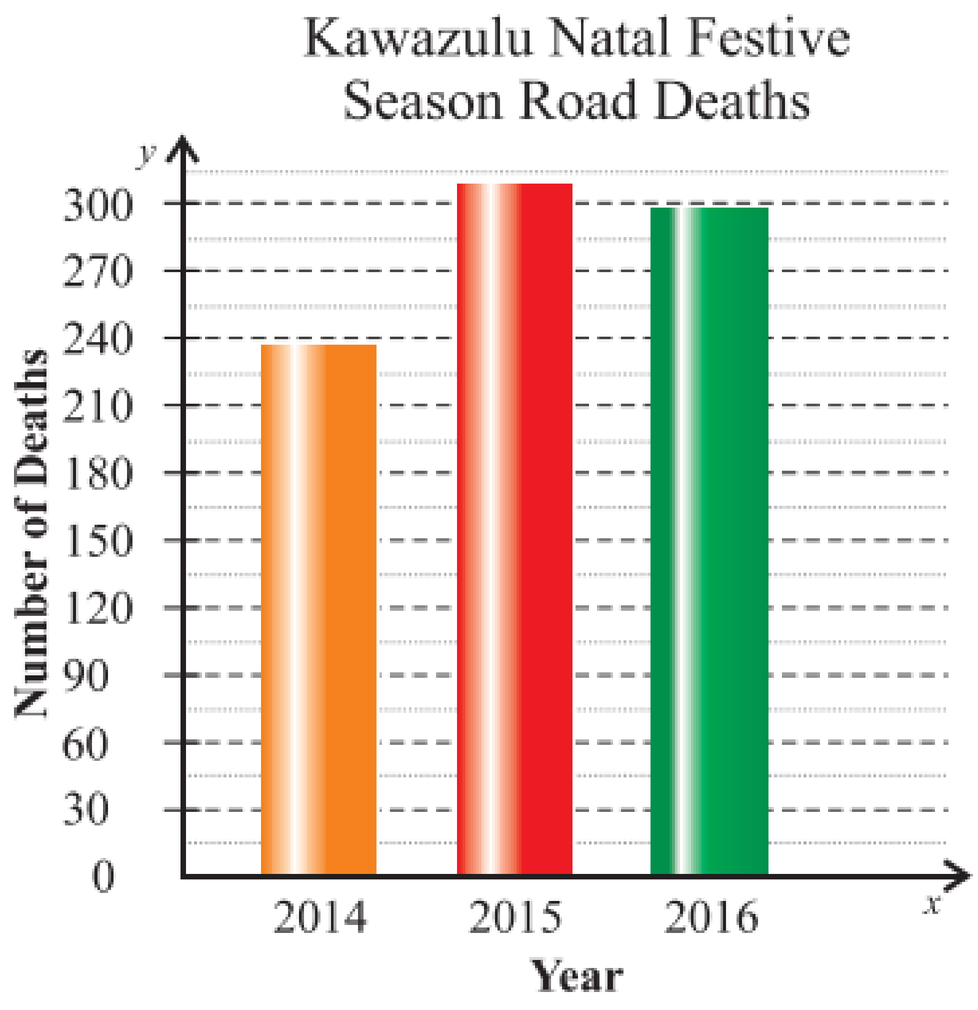
3. REPRESENT DATA

- Once data has been collected and organised it can be represented graphically.
- You have learnt many ways to represent data graphically. These include:
  - Histograms
  - Bar graphs
  - Pie Charts
  - Scatter plots
  - Broken line graphs
- Graphical representations can be manipulated to be misleading. Consider the bar graphs shown below representing the drop in road deaths in Kwazulu Natal from 2015 to 2016:





Both graphs represent the same information. By looking at the first graph there seems to have been a significant drop in road deaths from 2015 to 2016 festive season. However, the actual drop in road deaths was from 308 to 302. The graph achieves this by starting at a high number and increasing in small increments. It also omits the previous year's statistics.

The graph on the right shows a more accurate picture by increasing in larger increments and showing previous years' data. From the graph on the right it can be seen there was a large increase in deaths from 2014 to 2015.
Although there was a small decrease in deaths in 2016 it was still a significant increase from 2014.

4. ANALYSE, INTERPRET AND REPORT

- The last stage of the data cycle is to analyse, interpret and report on the data.
- The data is analysed using the measures of central tendency and dispersion which you have learnt in this chapter.
- The data can then be reported to provide information relating to the initial problem statement.

The Mixed Exercise on pages 386 and 387.

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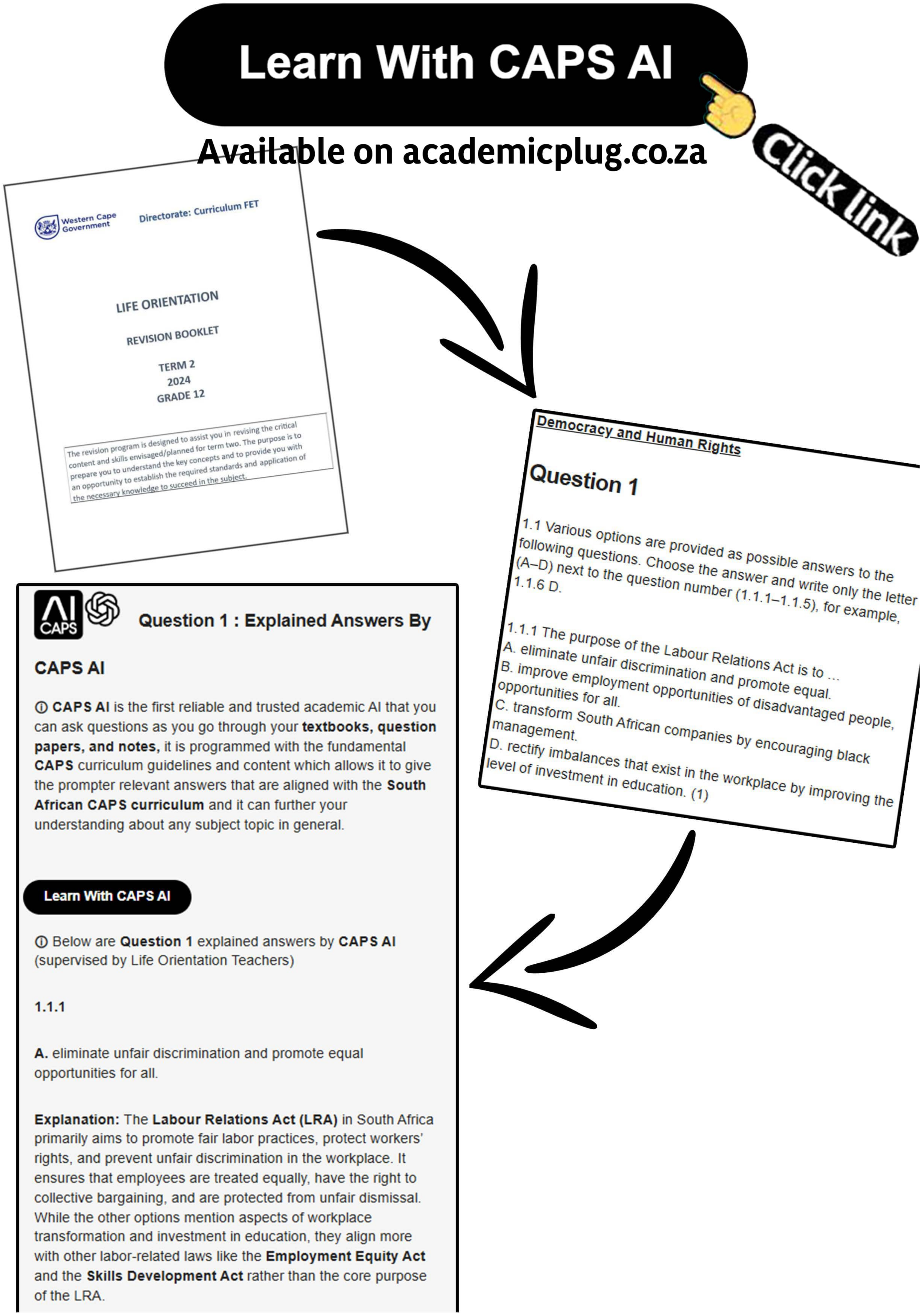
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Democracy and Human Rights
Question 1
1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.
1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)
Question 1 : Explained Answers By CAPS AI
ⓘ CAPS AI is the first reliable and trusted academic AI that you can ask questions as you go through your textbooks, question papers, and notes, it is programmed with the fundamental CAPS curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the South African CAPS curriculum and it can further your understanding about any subject topic in general.
Learn With CAPS AI
ⓘ Below are Question 1 explained answers by CAPS AI (supervised by Life Orientation Teachers)
1.1.1
A. eliminate unfair discrimination and promote equal opportunities for all.
Explanation: The Labour Relations Act (LRA) in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the Employment Equity Act and the Skills Development Act rather than the core purpose of the LRA.

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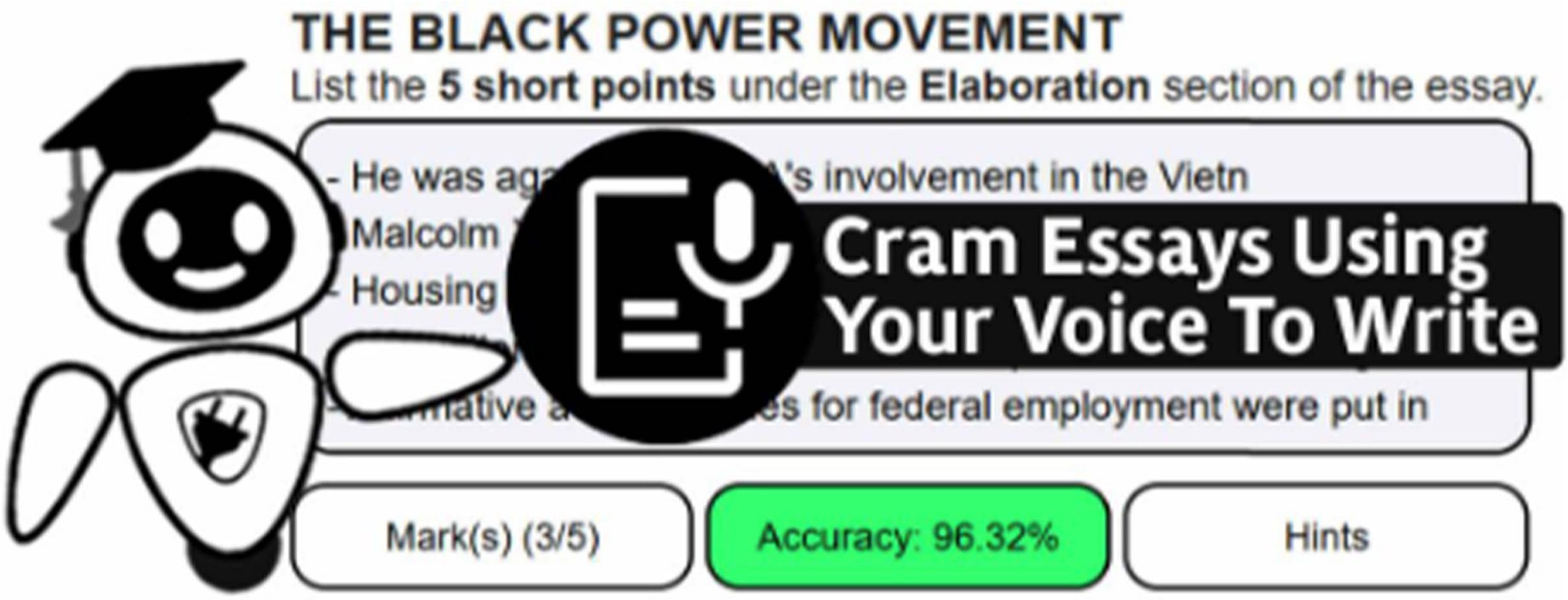

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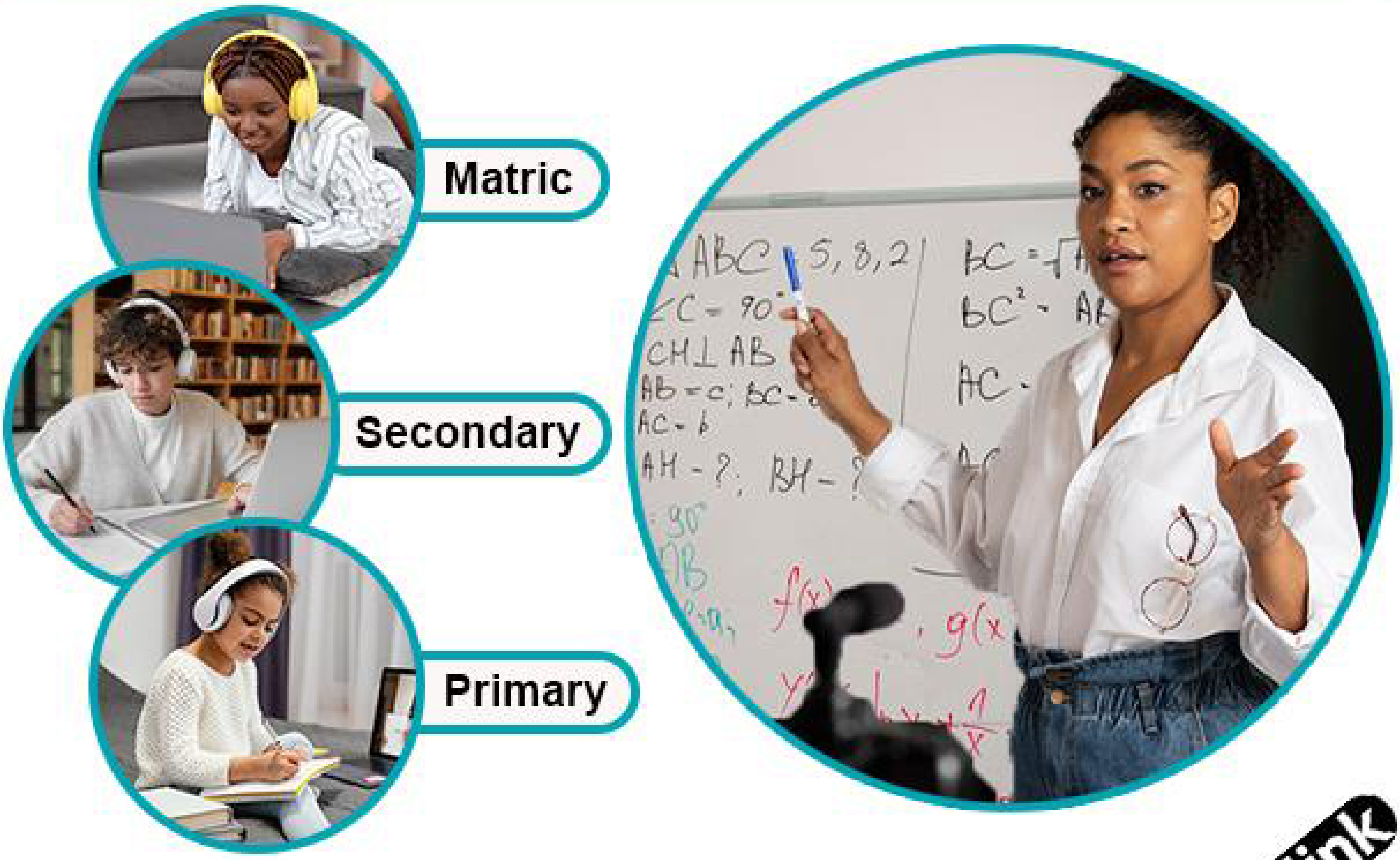

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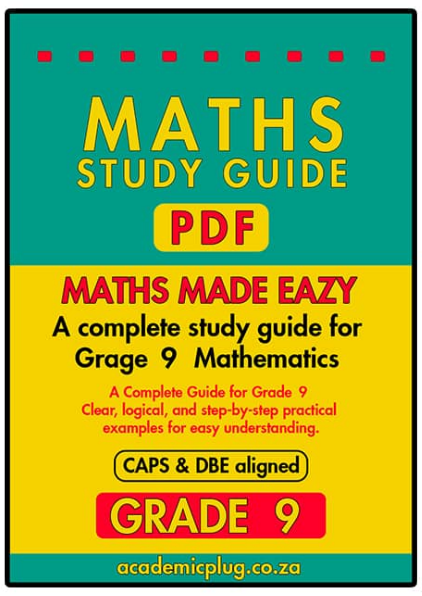

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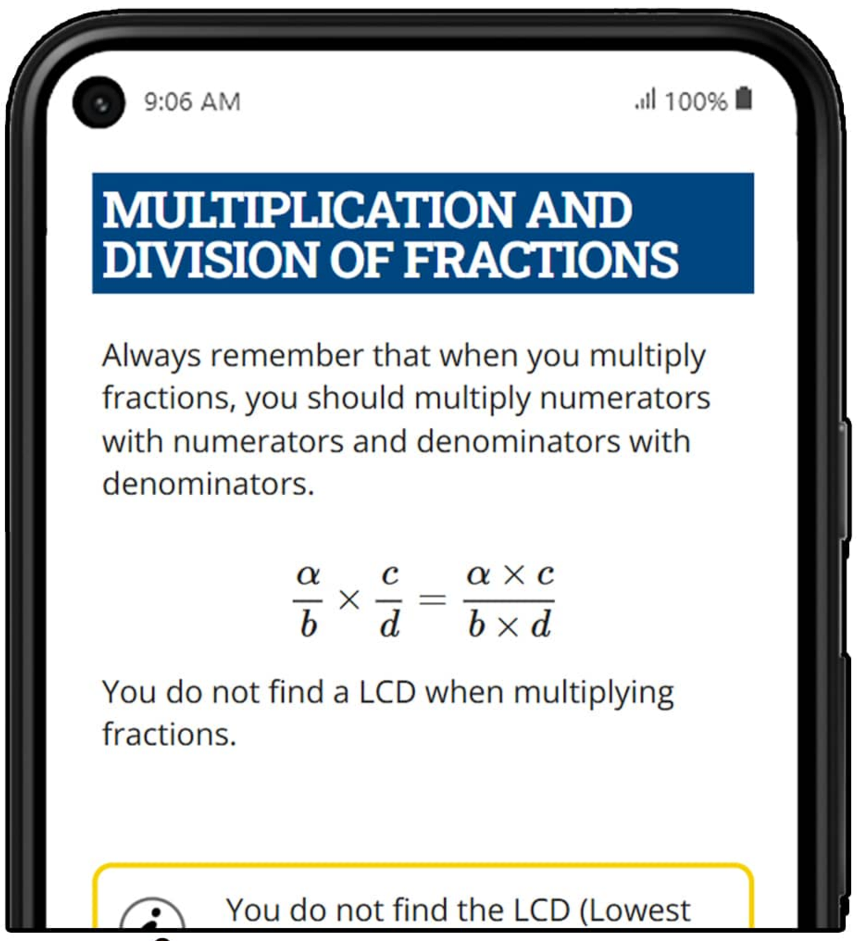

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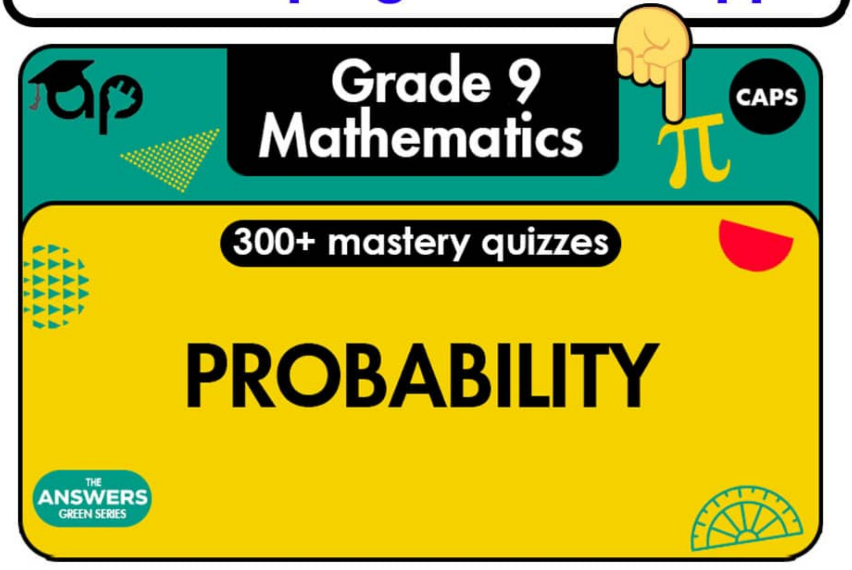

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CHAPTER 21 – PROBABILITY

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
228	**A. Grade 8 Revision**	5.4	• Consider situations with equally probable outcomes, and determine probabilities of compound events using two-way tables and tree diagrams
229	• Relative Frequency (Experimental Probability)		• Determine the probabilities of outcomes of events and predict their relative frequency in simple experiments
229	• Types of Events and The Probability Scale		• Compare relative frequency with probability and explain possible differences
230	• Probability (Theoretical Probability)		
233	• Making Predictions Using Probability		
234	**B. Compound Events**		
234	• Tree Diagrams		
237	• Two-Way Tables		

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A. GRADE 8 REVISION

Probability is a branch of Mathematics that **studies the likelihood of something happening**. It is important that you understand and are familiar with the terminology used throughout this section.

Probability

Probability is the **likelihood of something happening**.

Experiment

An **experiment** is a **method of testing probability**.
An example of an experiment is tossing a coin or throwing a dice.

Trial

In an experiment of tossing a coin or throwing a dice, each toss of the coin or throw of a dice would be a trial. A single experiment normally involves many trials.

Outcome

The **result of each trial** is called an **outcome**. If a coin were tossed the outcome would be a head or tail.

Sample Space

The **sample space** is a list (set) of **all of the possible outcomes**.
If two coins are tossed there are 4 possible outcomes:

1) **Head** and **Head**
2) **Head** and **Tail**
3) **Tail** and **Head**
4) **Tail** and **Tail**

The sample space is written as: S = {HH, HT, TH, TT}

Event

An **event** is a **set of specific outcomes** (a subset of the sample space).
The event that you would like to occur in an experiment is known as a **favourable outcome**.
In an experiment where a dice is thrown the sample space is: $S = \{1, 2, 3, 4, 5, 6\}$

If the event you are looking for is obtaining an odd number, the set A, of favourable outcomes would be written as: $A = \{1, 3, 5\}$

Frequency

The **number of times a particular outcome occurs** is called the **frequency** of that outcome.
If a coin is tossed 10 times, and the coin lands on heads 6 times and tails 4 times, the frequency of the outcome heads is 6 and the frequency of the outcome tails is 4.

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RELATIVE FREQUENCY (EXPERIMENTAL PROBABILITY)

Relative frequency is the **number of times a particular event occurs in relation to the number of trials performed**.
Relative Frequency is used for data obtained from an experiment which is performed.

Relative Frequency:

$$\textbf{Relative Frequency} = \frac{\textbf{number of times the event occurs}}{\textbf{total number of trials}}$$

Example: **In a study of 200 babies which were born in a hospital, 108 were girls and 92 were boys. What is the relative frequency of a girl being born?**

$$\text{relative frequency} = \frac{\text{number of times the event occurs}}{\text{total number of trials}}$$

$= \frac{108}{200}$ → girls occured 108 times out of 200 trials

$= \frac{27}{50}$

$= 0{,}54$

$= 54\%$ → answers can be given as a fraction, decimal or percentage

TYPES OF EVENTS AND THE PROBABILITY SCALE

Impossible Events

Impossible events have a probability of 0.
An example of an impossible event would be obtaining a 10 when rolling a single dice.

Even Chance Events

Even events are events which have a 50% chance (probability) of occurring.
Tossing a fair coin is an even chance event as there is 50% chance of obtaining a head or tail.

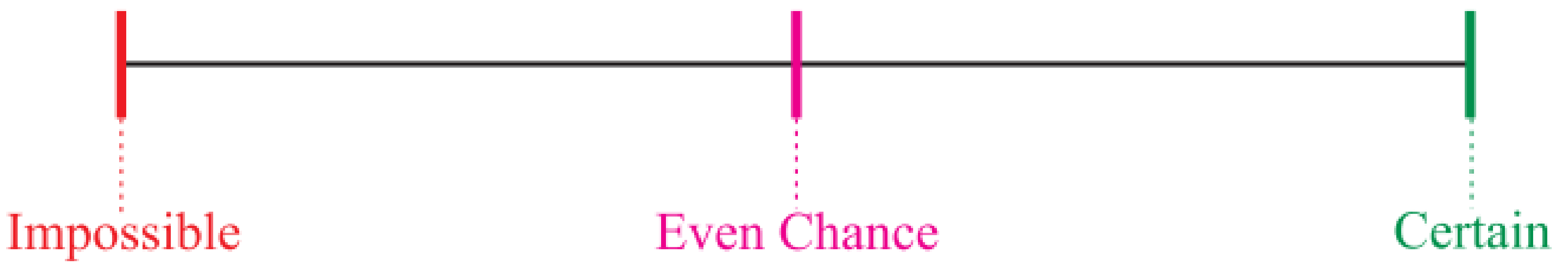
Certain Events

Certain events have a probability of 1 (100%). An example of a certain event is that the sun will rise every morning in South Africa.

The Probability Scale

Impossible, **even** and **certain events** can be represented on a **probability scale** as shown below. Probability can be expressed as a fraction, decimal or percentage.

Probability written as a:			
Fraction	0	$\frac{1}{2}$	1
Decimal	0	0,5	1
Percentage	0%	50%	100%



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PROBABILITY (THEORETICAL PROBABILITY)

It is logical that if a fair coin is tossed the probability of obtaining a head is 0,5 (50%) and the probability of obtaining a tail is 0,5 (50%).
If you toss a coin 10 times you will not necessarily get 5 heads and 5 tails. However, if you toss a coin 1000 times you will get closer to the 50% probability of a head or a tail.
In most cases, it takes a large number of trials before experimental and theoretical probability approach the same answers.

Probability:

$$\text{Probability} = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

Example 1: A fair dice is tossed. What is the probability of rolling an odd number?

In this example, a favourable outcome is an odd number. The odd numbers on a dice are 1, 3 and 5. This means there are **three favourable outcomes** out of a **possible six outcomes** (1, 2, 3, 4, 5 and 6).

$$\begin{aligned}\text{Probability} &= \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}\\ &= \frac{3}{6}\\ &= \frac{1}{2}\\ &= 0{,}5 \rightarrow \text{this is a 50\% chance}\end{aligned}$$

Example 2: A bag contains 5 green balls, 2 orange balls, 3 blue balls and 10 red balls. A ball is randomly selected from the box. Give all answers as a decimal.

a) What is the probability of selecting a red ball?
b) What is the probability of selecting a blue ball?
c) What is the probability of selecting a green ball?
d) What is the probability of selecting an orange or green ball?
e) What is the probability of selecting a red or a blue ball?
f) What is the probability of not selecting a red ball?

a) $$\begin{aligned}\text{Probability} &= \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}\\ &= \frac{10}{20} \rightarrow \text{there are 10 red balls out of a total of 20 balls}\\ &= \frac{1}{2}\\ &= 0{,}5\end{aligned}$$

b) $$\begin{aligned}\text{Probability} &= \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}\\ &= \frac{3}{20} \rightarrow \text{there are 3 blue balls out of a total of 20 balls}\\ &= 0{,}15\end{aligned}$$

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c) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$$= \frac{5}{20} \rightarrow \text{there are 8 green balls out of a total of 20 balls}$$
$$= \frac{1}{4}$$
$$= 0{,}25$$

d) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$$= \frac{2+5}{20} \rightarrow \text{there are 2 orange and 5 green balls out of a total of 20 balls}$$
$$= \frac{7}{20}$$
$$= 0{,}35$$

e) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$$= \frac{10+3}{20} \rightarrow \text{there are 10 red and 3 blue balls out of a total of 20 balls}$$
$$= \frac{13}{20}$$
$$= 0{,}4$$

f) **The probability of not selecting a red ball is 1 – probability of selecting a red ball:**

$$\text{Probability}(\text{not selecting red}) = 1 - \text{Probability}(\text{selecting red})$$
$$= 1 - \frac{10}{20}$$
$$= 0{,}5$$

Example 3: A local Bowls Club is holding a raffle for charity. In the draw, the numbers 0 to 49 will be written on cards and placed in a bag. Two cards will be randomly selected. Each person who entered the raffle selected two numbers. To win the prize a contestant must have selected the same numbers that are drawn in any order. If Johnny selected the numbers 4 and 12 what is the probability that Johnny wins a prize? Give your answer as a percentage.

$\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$$= \frac{2}{50} \rightarrow \text{2 numbers were selected out of a total of 50 numbers}$$
$$= \frac{1}{25}$$
$$= 0{,}04$$
$$= 4\%$$

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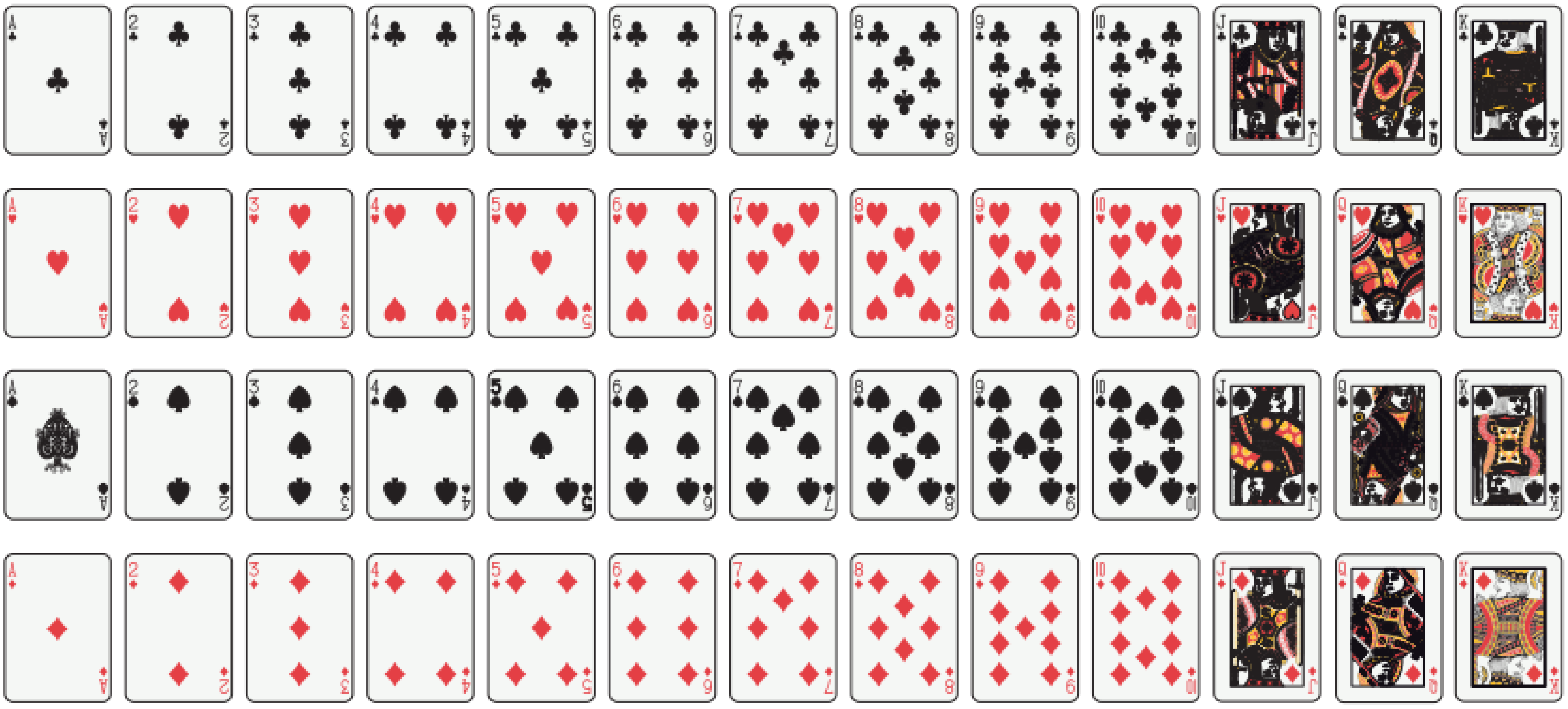
Example 4: A pack of playing cards is shown below. If a card is randomly selected:



a) What is probability of selecting an ace? Leave your answer as a fraction.
b) What is probability of selecting a red jack? Leave your answer as a fraction.
c) What is probability of selecting a black card? Leave your answer as a fraction

In a pack of playing cards there are 4 suits:

- **Clubs**
- **Hearts**
- **Spades**
- **Diamonds**

Each suit has 13 cards and there is a total of 52 cards in a deck. When dealing with probability, you assume that the pack does not contain any jokers.

a) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{4}{52} \rightarrow$ there are 4 aces in a deck

$= \dfrac{1}{13}$

b) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{2}{52} \rightarrow$ there are 2 red jacks in a deck

$= \dfrac{1}{26}$

c) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{26}{52} \rightarrow$ there are 26 black cards in a deck in a deck

$= \dfrac{1}{2}$

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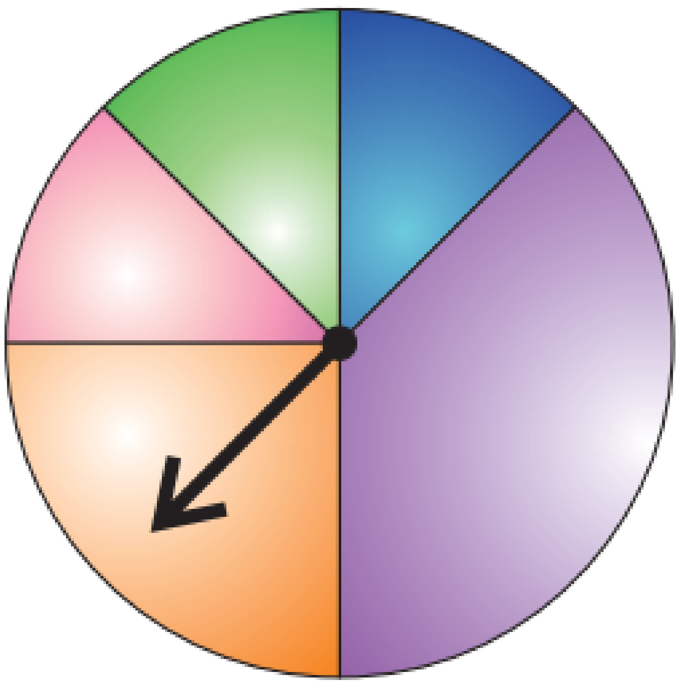
MAKING PREDICTIONS USING PROBABILITY

Predicted number of times an event will occur:

Number of times an event will occur = (probability of the event)(number of trials)

<u>**Example**</u>: **In the spinner alongside, the blue, green and pink sections are equal in area and the orange section occupies a quarter of the spinner. Together, the pink and green section occupy the same area as the orange section. Answer the questions below leaving your answers in fraction form where applicable.**



a) What fraction of the spinner is purple?
b) What is the probability of spinning blue or purple?
c) If the spinner is spun 160 times how many times would you expect to land on pink?
d) If the spinner is spun 120 times how many times would you expect to spin blue or purple?

a) From the given information, the pink, green and blue sections each occupy $\frac{1}{8}$ of the circle.

$$\therefore \text{Purple sector} = 1 - \frac{1}{4} - \frac{1}{8} - \frac{1}{8} - \frac{1}{8}$$
$$= \frac{3}{8}$$

b) $P(\text{blue or purple}) = \frac{1}{8} + \frac{3}{8}$ → this is shorthand for writing probability of blue or purple

$$= \frac{4}{8}$$
$$= \frac{1}{2}$$

c) number of green spins $= \frac{1}{8} \times 160$ → probability of pink × number of spins

$$= 20$$

d) number of blue or purple spins $= \frac{4}{8} \times 120$ → probability of blue or purple × number of spins

$$= 60 \text{ times}$$

Complete Exercise 1 on page 395.

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B. COMPOUND EVENTS

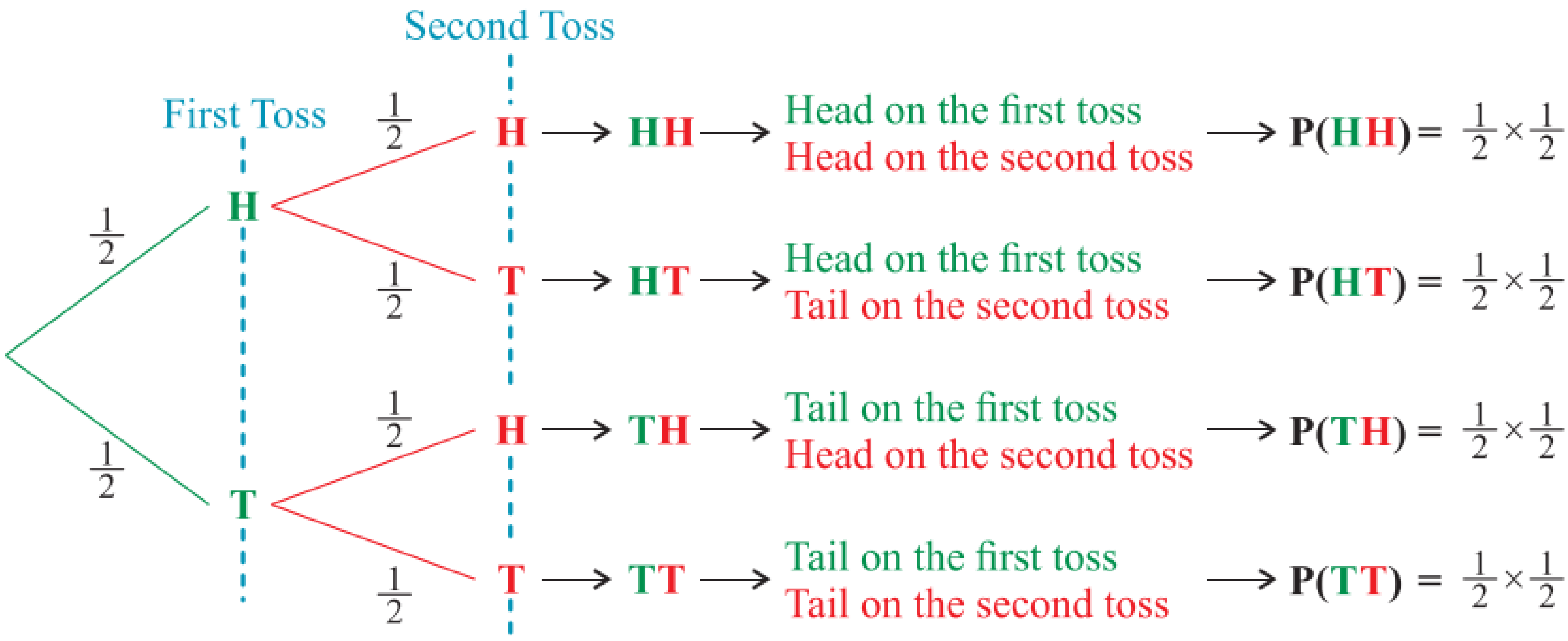
A **compound event** is when **two events occur one after the other**.
In this section, we will examine probability for compound events.
There are two methods of visually representing compound events:

1. **Tree Diagrams**
2. **Two-Way Tables**

1. TREE DIAGRAMS

When drawing a tree diagram **each branch represents the probability of a certain outcome**.
Each set of branches represents an event.

Illustrative Example: A fair coin is tossed twice. Draw a tree diagram to show all the possible outcomes.



In the above diagram, the **green branches** show all the possible outcomes of **the first toss**. The probability of each outcome in the first toss is written on top of each branch.

The **red branches** show all the possible outcomes of **the second toss**. Again, the probability of each outcome is written on top of each branch.

The probability of each event is calculated by multiplying along the branches.
In this case, each event is equally likely. The table below shows how to calculate the probability of each event:

Outcome	Probability
Head Head (HH)	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
Head Tail (HT)	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
Tail Head (TH)	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
Tail Tail (TT)	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

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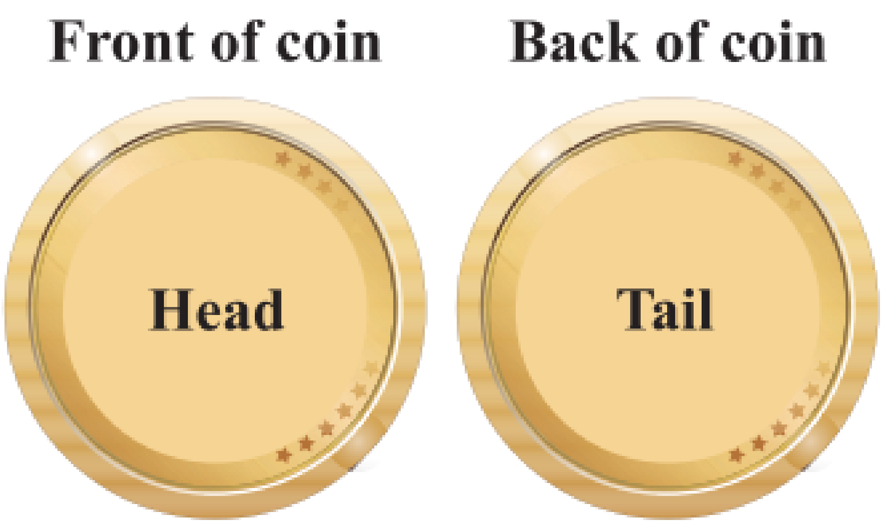
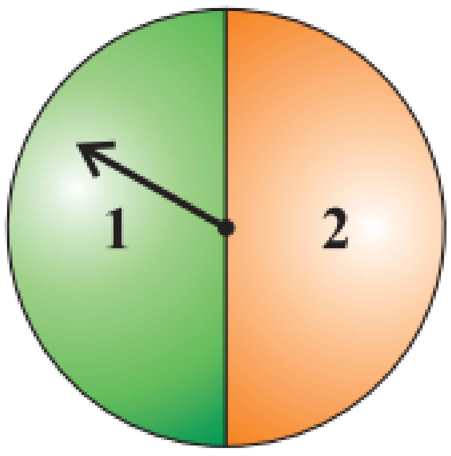
Example 1: **The coin shown below is tossed followed by spinning the spinner on the right. The coin is weighted so that it is more likely to land on heads than tails. The probability of it landing on heads is 0,75. The spinner is equally likely to land on 1 or 2.**

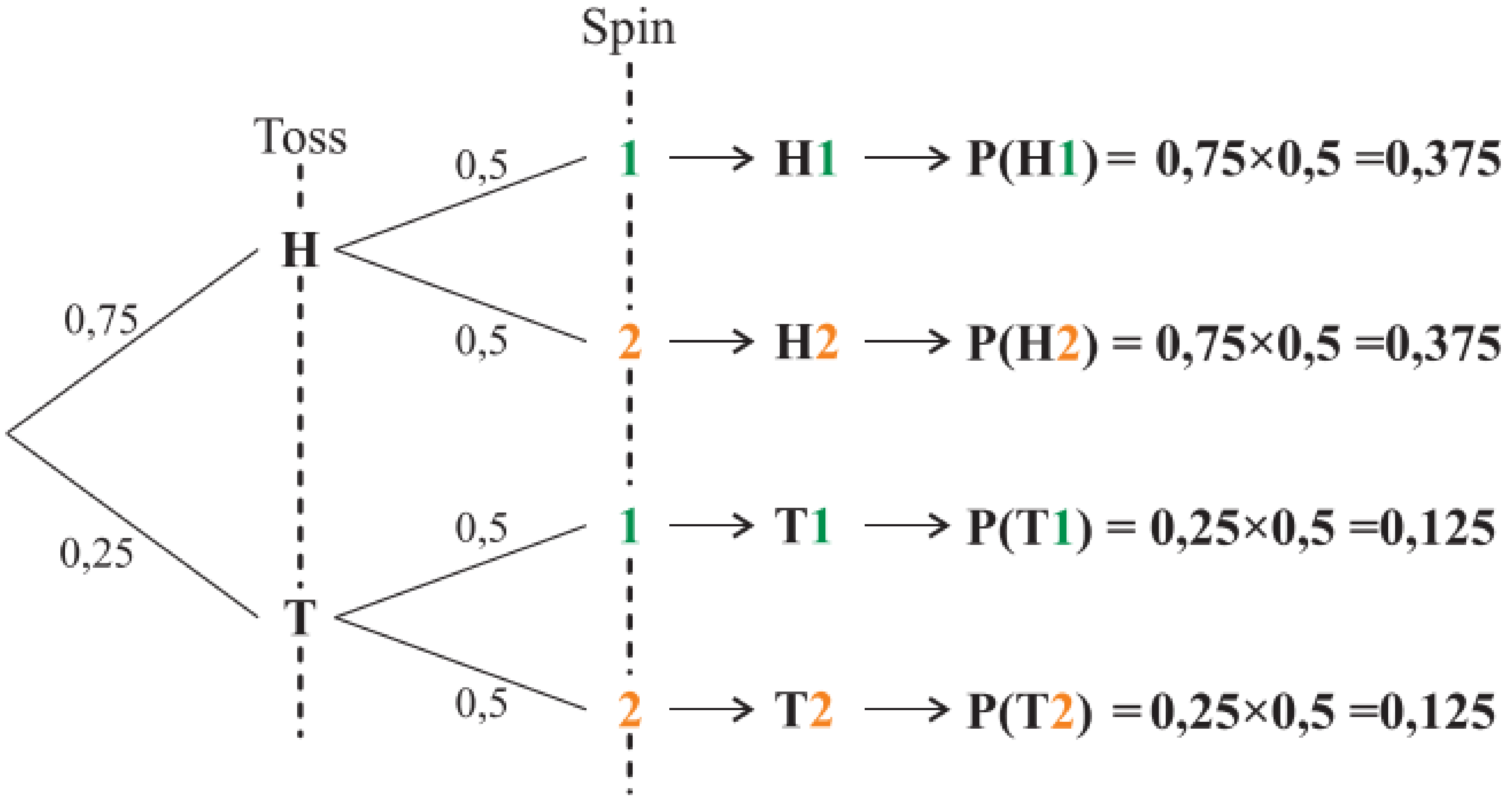




a) What is the probability of obtaining a tail in a single toss?
b) Draw a tree diagram to show all the possible outcomes.
c) What is probability of obtaining a 1 in the above experiment?
d) What is the probability of obtaining a tail or a 1 in the above experiment?

a) $P(\text{Tail}) = 1 - 0,75$ → there is a 100% chance that either a head or tail is obtained
$= 0,25$

b)



c) $P(1) = 0,375 + 0,125 \rightarrow P(H1) + P(T1)$
$= 0,5 \rightarrow P(H1) + P(T1)$

d) $P(\text{Tail or } 1) = 0,375 + 0,125 + 0,125 \rightarrow P(H1) + P(T1) + P(T2)$
$= 0,625$

In a tree diagram, multiply along branches and add when moving down at the end of the tree.

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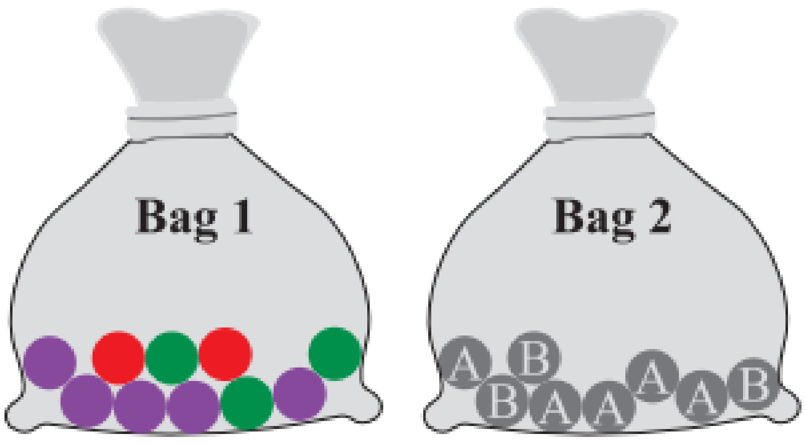
<u>Example 2</u>: **Lindiwe has two bags. One bag contains 5 purple balls, 3 green balls and 2 red balls. The other bag contains 5 balls with the letter A and 3 balls with the letter B on it. A ball is drawn from the bag with coloured balls and then from the bag with lettered balls.**



a) If a ball is randomly selected from bag 1, determine the probability of obtaining a purple, green and red ball.

b) If a ball is randomly selected from bag 2, determine the probability of obtaining the letter A and the Letter B.

c) Draw a tree diagram to show all the possible outcomes of the experiment.

d) Determine the probability of obtaining a red ball.

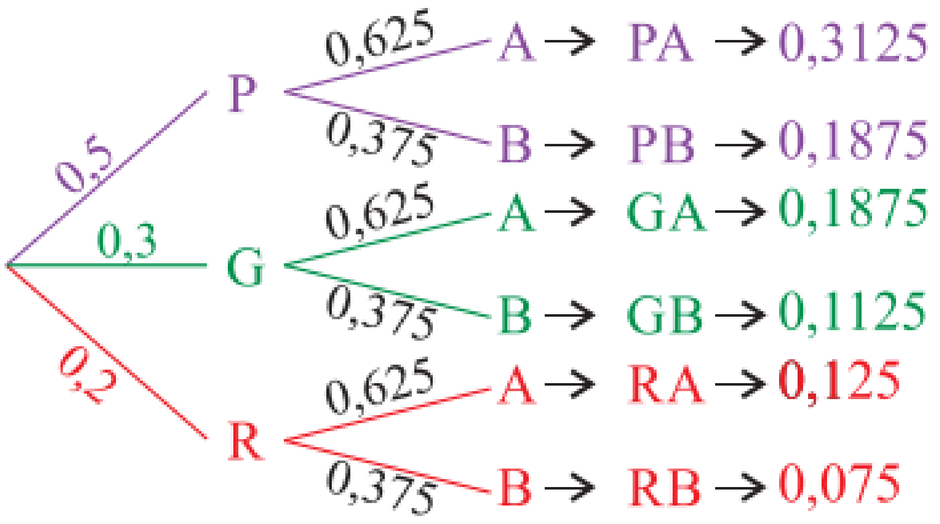
e) Determine the probability of obtaining the letter A or a green ball.

a) $P(P) = \frac{5}{10}$ $= 0,5$ $\qquad P(G) = \frac{3}{10}$ $= 0,3$ $\qquad P(R) = \frac{2}{10}$ $= 0,2$

b) $P(A) = \frac{5}{8}$ $\qquad P(B) = \frac{3}{8}$

$P(A) = 0,625 \qquad = 0,375$

c)



d) A red ball can be obtained in 2 ways, a red ball is picked followed by the letter A, or a red ball is picked followed by the letter B. Using the tree diagram:

$P(\text{red}) = 0,125 + 0,075 \rightarrow P(RA) + P(RB)$

$= 0,2$

e) $P(\text{A or green}) = 0,3125 + 0,1875 + 0,1125 + 0,125 \rightarrow P(PA) + P(GA) + P(GB) + P(RA)$

$= 0,7375$

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2. TWO-WAY TABLES

A **two-way** table is a way of representing **every possible outcome** of an experiment in **table form**.

Example 3: Two dice are rolled and the numbers on each face are written down.

a) Draw a two-way table of all the possible outcomes.
b) What is the probability of obtaining the same numbers on both dice?
c) What is the probability of obtaining an even number on one dice and an odd number on the other?
d) If the numbers on each dice are added together, what is the probability that the sum is greater than 12?

a)

		First Dice					
		1	**2**	**3**	**4**	**5**	**6**
Second Dice	**1**	**1 ; 1**	**2 ; 1**	3 ; 1	**4 ; 1**	5 ; 1	**6 ; 1**
	2	**1 ; 2**	**2 ; 2**	**3 ; 2**	4 ; 2	**5 ; 2**	6 ; 2
	3	1 ; 3	**2 ; 3**	**3 ; 3**	**4 ; 3**	5 ; 3	**6 ; 3**
	4	**1 ; 4**	2 ; 4	**3 ; 4**	**4 ; 4**	**5 ; 4**	6 ; 4
	5	1 ; 5	**2 ; 5**	3 ; 5	**4 ; 5**	**5 ; 5**	**6 ; 5**
	6	**1 ; 6**	2 ; 6	**3 ; 6**	4 ; 6	**5 ; 6**	**6 ; 6**

b) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{6}{36}$ → there are 6 sets where the numbers are the same (orange in the table)

$= \dfrac{1}{6}$

c) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{18}{36}$ → there are 18 even and odd pairs (shown in green in the table)

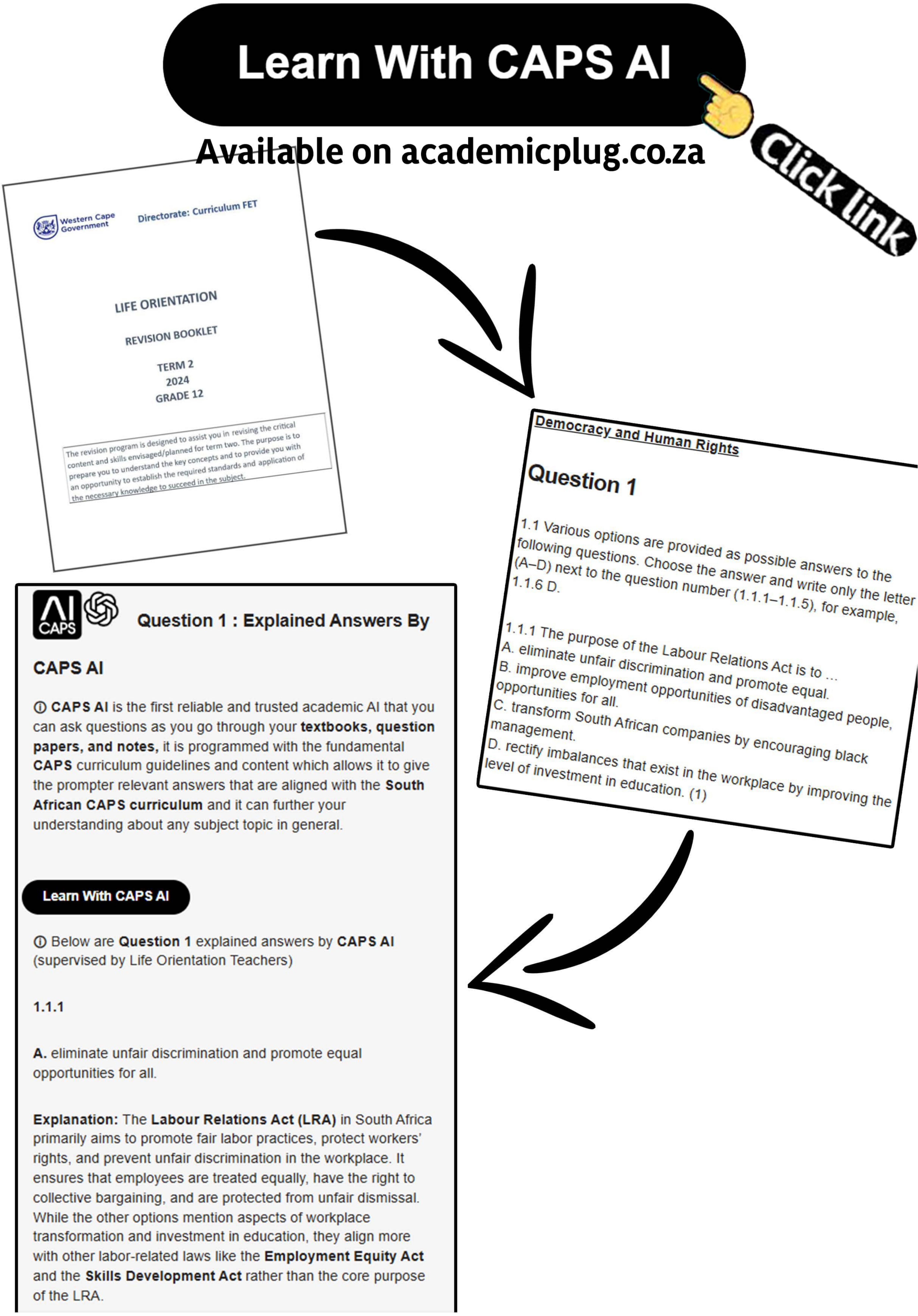
$= \dfrac{1}{2}$

d) $\text{Probability} = \dfrac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \dfrac{0}{36}$ → largest number that can be obtained is 12 when 6 and 6 are added

$= 0$

Complete Exercise 2 on pages 395 and 396 and the Mixed Exercise on pages 396 and 397.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The revision program is designed to assist you in revising the critical content and skills envisaged/planned for term two. The purpose is to prepare you to understand the key concepts and to provide you with an opportunity to establish the required standards and application of the necessary knowledge to succeed in the subject.
Democracy and Human Rights
Question 1
1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5), for example, 1.1.6 D.
1.1.1 The purpose of the Labour Relations Act is to ...
A. eliminate unfair discrimination and promote equal opportunities for all.
B. improve employment opportunities of disadvantaged people.
C. transform South African companies by encouraging black management.
D. rectify imbalances that exist in the workplace by improving the level of investment in education. (1)
AI CAPS
Question 1 : Explained Answers By CAPS AI
ⓘ CAPS AI is the first reliable and trusted academic AI that you can ask questions as you go through your textbooks, question papers, and notes, it is programmed with the fundamental CAPS curriculum guidelines and content which allows it to give the prompter relevant answers that are aligned with the South African CAPS curriculum and it can further your understanding about any subject topic in general.
Learn With CAPS AI
ⓘ Below are Question 1 explained answers by CAPS AI (supervised by Life Orientation Teachers)
1.1.1
A. eliminate unfair discrimination and promote equal opportunities for all.
Explanation: The Labour Relations Act (LRA) in South Africa primarily aims to promote fair labor practices, protect workers' rights, and prevent unfair discrimination in the workplace. It ensures that employees are treated equally, have the right to collective bargaining, and are protected from unfair dismissal. While the other options mention aspects of workplace transformation and investment in education, they align more with other labor-related laws like the Employment Equity Act and the Skills Development Act rather than the core purpose of the LRA.

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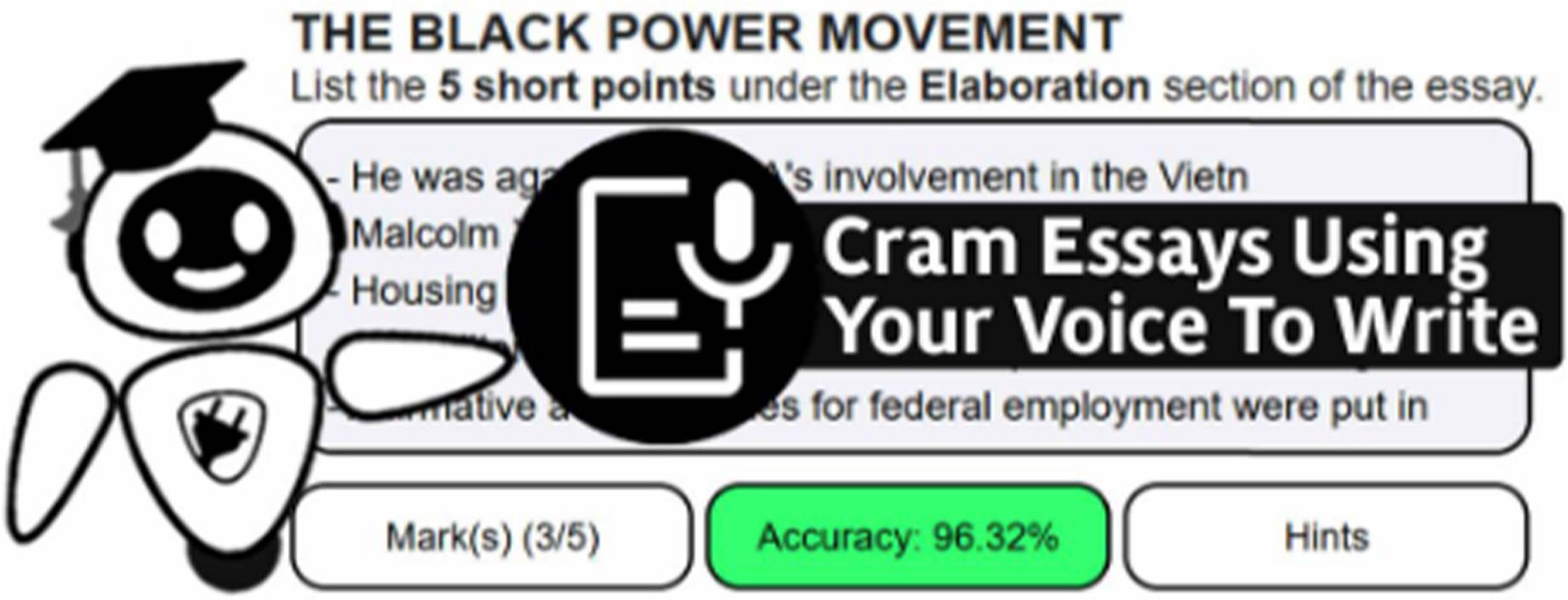

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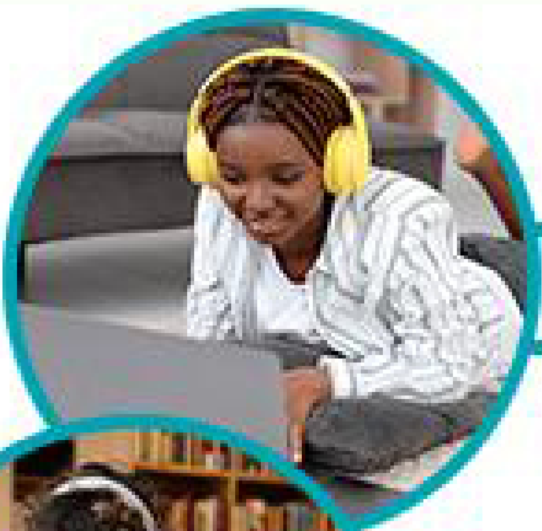

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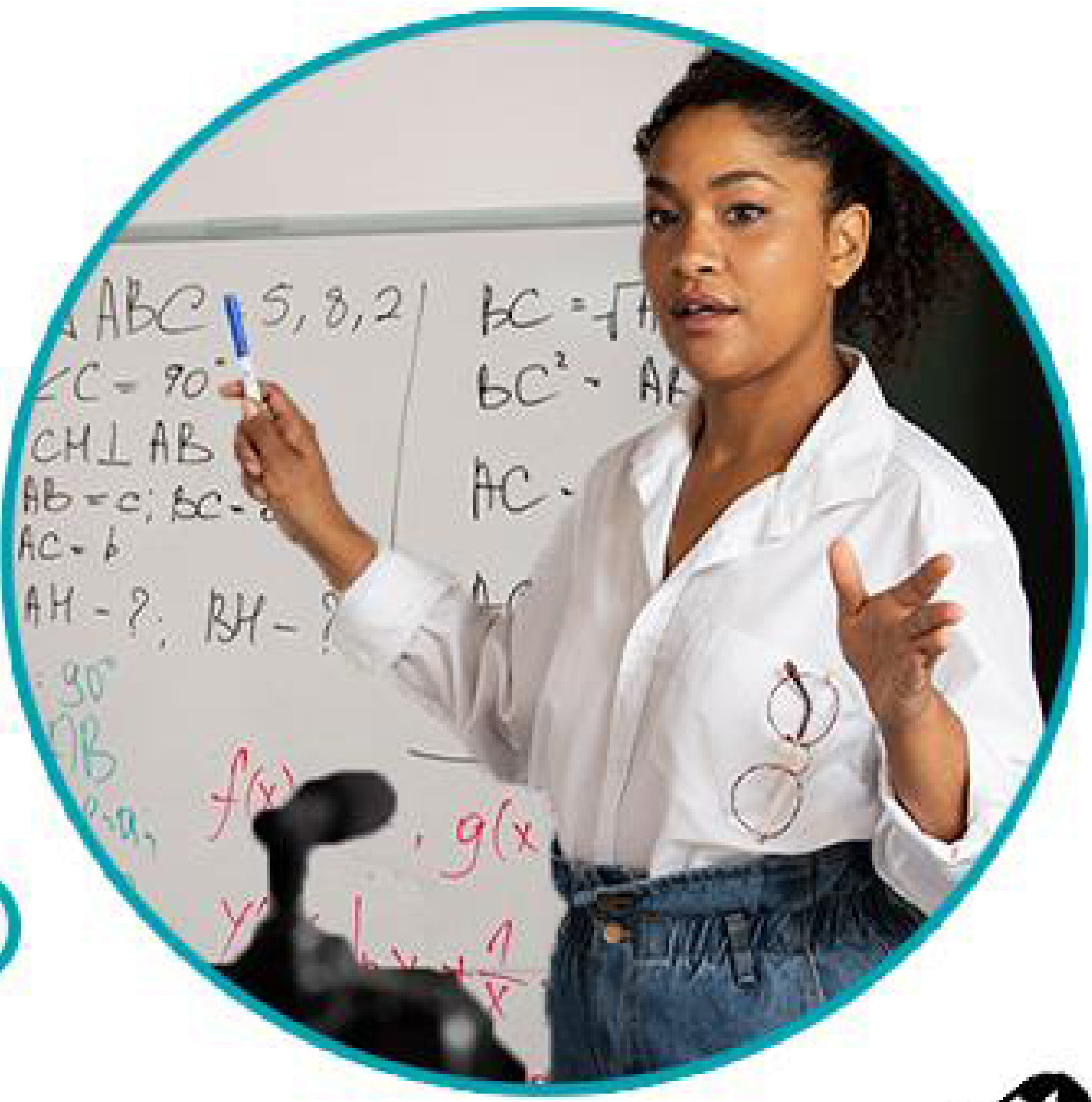

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CHAPTER 22
MAKING THE MOST OF MATHS

WHAT YOU WILL LEARN IN THIS CHAPTER

PAGE	CONTENT	CAPS	ASSESSMENTS YOU WILL BE ABLE TO:
239	A. Maths in the Classroom		• Get the most out of mathematics in your classroom
239	B. Exam Study Techniques		• Study with confidence and use your time effectively
239	C. The Morning of the Exam		• Relax and walk into your exam with confidence
240	D. Exam Writing Techniques		• Write your exam neatly and use your time efficiently

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A. MATHS IN THE CLASSROOM

- Up to **80% of learning** should be achieved in the **classroom**. Try to sit as close as possible to the front of the classroom where you can see and hear properly.

- **Concentrate** and avoid the temptation to talk to your friends. Missing an explanation could result in a misunderstanding of an entire section.

- **Do not be shy!** If you don't understand an explanation that your teacher has given, put your hand up and say so. **Ask** your teacher to explain it again until you do understand. If you did not understand a concept, it is likely that the majority of your class is in the same position.

B. EXAM STUDY TECHNIQUES

- **Practising past exam papers** is the most helpful and practical form of revision. Past papers expose you to the required level of work, exam format and the necessary time limitations imposed on you.

- **Make sure you start studying early.** You should start with past papers at least two weeks before the exam. Make sure that as you do each question you check your answer. If you check your answers after you have completed the whole paper, you cannot remember what each question was about. This means that you do not learn from your mistakes.

- **In order to achieve the correct pace**, while timing yourself, do an entire past paper and only check your answers at the end of the paper. This should be done two to three days before your exam.

- Ensure the room that you are studying in is **brightly lit** and **properly ventilated**.

- **Cellular phones** can be your worst enemy whilst studying. **Turn your phone off** and check your messages only when you have finished studying.

C. THE MORNING OF THE EXAM

- Make sure that **everything you need for your exam is packed the night before** and ready to take in the morning. Ensure your **calculator is in the correct mode** with charged batteries. It is a good idea to take a spare calculator into your exam.

- **Sleep is very important**. Avoid going to bed too late or waking up very early to study. A maths test or exam requires a fresh brain.

- **Eat Breakfast!** Hunger affects concentration.

- **Avoid discussing work** before the exam. This is likely to cause confusion.

- You've worked hard and are **prepared** - now relax and enjoy the exam.

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D. EXAM WRITING TECHNIQUES

- **Read through the entire question paper before you start**. You can answer the questions in any order you like. Answer the questions that you are most confident in first. However, you must answer an entire question at once. Don't answer parts of a question in different places in your answer book. If you are unsure of a certain part of the question, leave it out and come back to it.

- **If you leave out part of a question, make sure you leave enough space to answer it**. Always leave at least half a page open if the question is worth more than two marks. If you are not sure how much space will be needed, be safe and leave a full page.

- **Mark questions** that you have **left out** on the question paper, so that you remember to come back to them.

- **Neatness is crucial**. Keeping your solutions **neat** and **legible** during an exam may result in up to a 5% increase in your results compared to an untidy and illegible answer book. Neat workings also assist you, as it is easier to check answers and find mistakes. In addition, neatness helps to avoid careless mistakes.

- **Do not** attempt to **save space** in your exams! Cramped work is messy and difficult to mark. Leave at least one line between answers. Similarly, do not write complicated fractions on a single line.

- **Never cross out an answer, unless** you have already written another answer to replace it. Once you have what you feel is the correct answer, only then cross out the incorrect workings.

- **Do not use** any type of **correction fluid** (eg. tippex) in a test or exam. Rather **cross out your answer neatly** and carry on.

- **Follow the layout** shown in this handbook. Keep to the top to bottom layout and the exam will be a pleasure to write and mark.

- An answer book that has the final answer of each question **underlined with an arrow** is very pleasant for a teacher to mark. However, this can be very costly in terms of time. **If you are a slow or untidy worker, use a ruler** and neatly underline your answers with arrows, **only once you are finished** your test or exam and have **checked** through **your solutions**. Make sure that you don't cross out your answer when doing this.

- Finally, **relax** and be **positive**. It is important that you **don't panic** at any stage during the exam.

Good luck – you have earned it!

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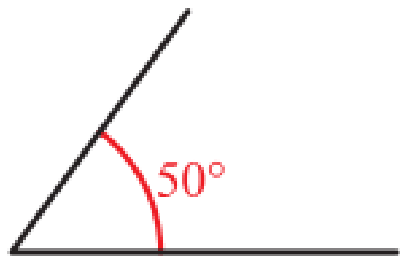
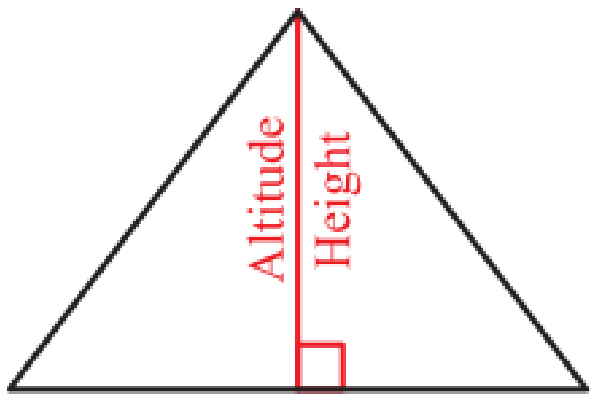
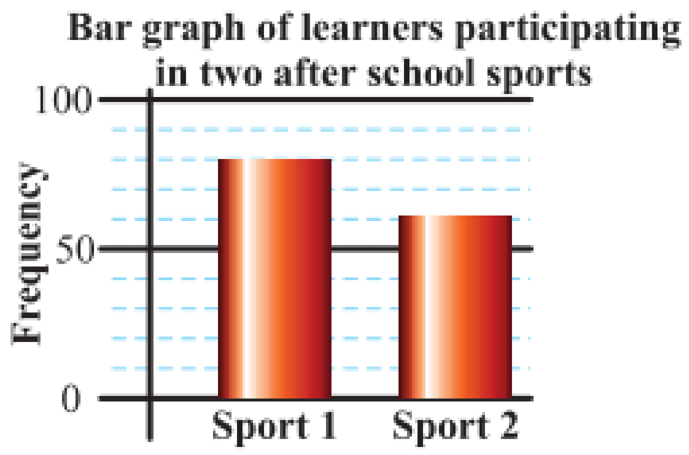
CHAPTER 23
GLOSSARY OF IMPORTANT TERMS AND SYMBOLS

Term	Explanation	Example (where possible)
Acute angle	An angle that is greater than 0° and less than 90°.	
Additive inverse	If two numbers sum to 0, they are additive inverses of each other.	The additive inverse of 2 is -2. This is because $2-2$ is equal to 0.
Altitude	A line from the vertex of a triangle perpendicular to the opposite base. This is another word for the height of a triangle.	
Associative property	The way in which numbers are grouped when adding or multiplying does not affect the solution	$(a+b)+c=a+(b+c)$ and $(a\times b)\times c=a\times(b\times c)$
Bar graph	A graph which uses bars to graphically illustrate discrete data. There are always gaps between the bars on a bar graph.	
Binomial	An expression which only has 2 terms.	The expression $x+1$ is a binomial

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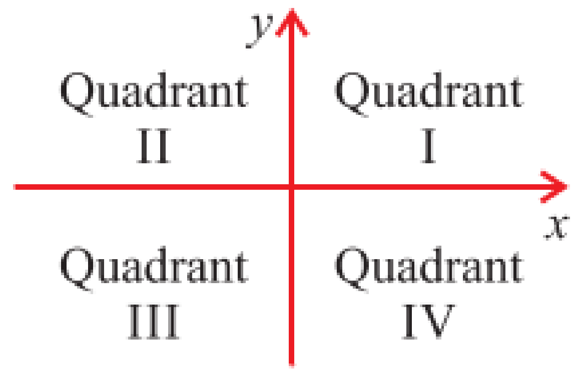
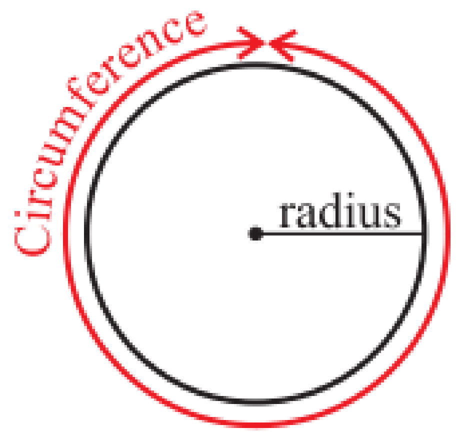
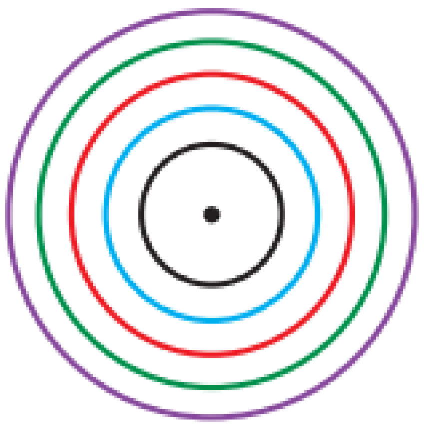
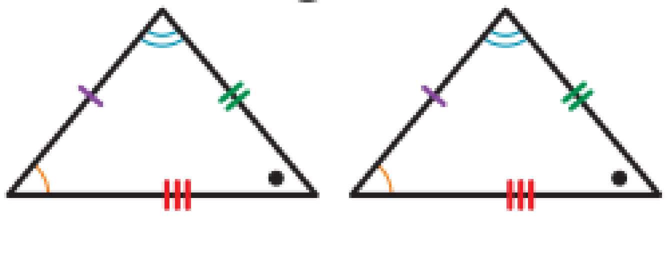
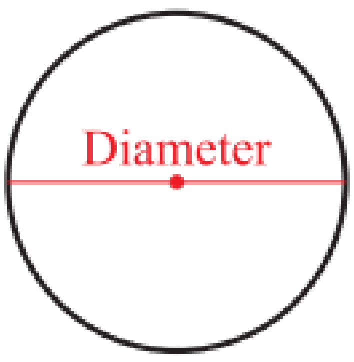
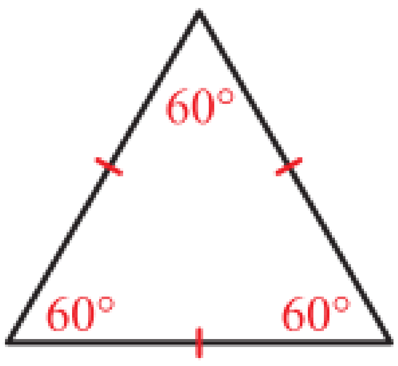
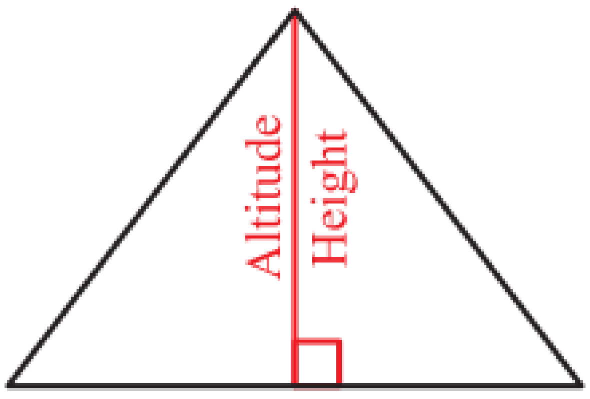
Term	Explanation	Example (where possible)
Cartesian plane	Four quadrants which are separated by an x and y-axis	
Circumference	The physical distance around a circle. (The perimeter of a circle) Formula: $C = 2\pi r$ *or* $C = \pi d$	
Coefficient	The number in front of a variable.	In the expression $2x^2 + 4$ The coefficient of x^2 is 2.
Constant term	The term in an expression that does not contain any variables.	In the expression $2x^2 + 4$ The constant is 4.
Concentric circles	Circles that have the same centre but different length radii.	
Consecutive numbers	Numbers that increase in ones. (follow on from one another)	…; 5; 6; 7; 8; 9; …
Congruent	If two shapes are congruent every angle and side are exactly equal on both shapes.	**The triangles below are congruent** 

Term	Explanation	Example (where possible)
Denominator	The number at the bottom of a fraction.	In the fraction $\frac{3}{x}$ The denominator is x.
Descending numbers	Numbers that are arranged from largest to smallest.	The numbers below are arranged in descending order: 10; 9; 8; 7; 6; 5; 4; 3; 2; 1
Diameter	A line through the centre of the circle that touches the circumference of the circle at two points.	
Direct Proportion	Two quantities are directly proportional to each other, if they increase or decrease in the same ratio.	If a wall is to be painted, the amount of paint required increases as the surface area of the wall increases. If the wall doubles in size, the amount of paint required also doubles.
Equilateral triangle	A triangle with 3 equal sides and all angles equal to 60°.	
Exponent (and base)	The number that a base is raised to.	In the term x^a, a is the exponent and x is the base.
Height	The perpendicular distance from the base of a shape to its highest point.	

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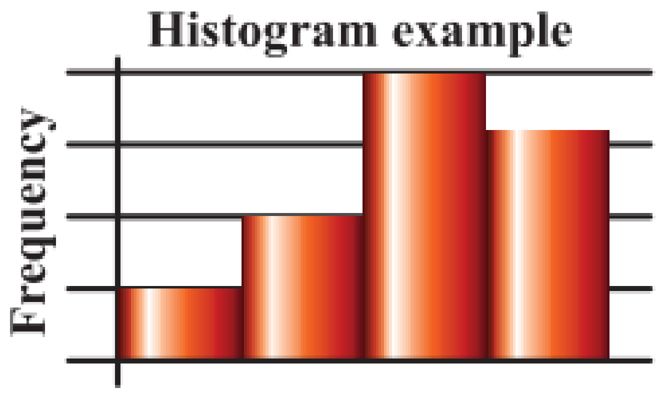
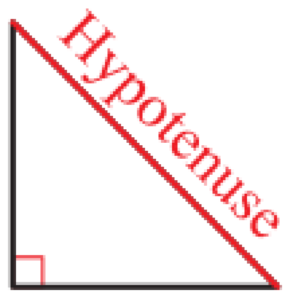
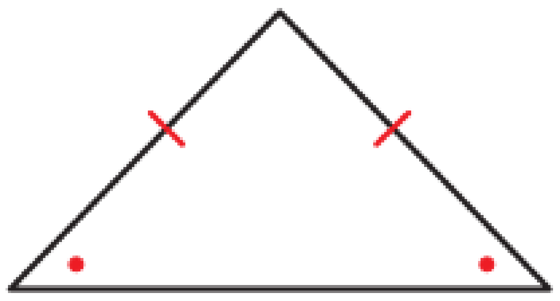
Term	Explanation	Example (where possible)
Histogram	A graph which uses bars to graphically illustrate continuous data. There are no gaps between the bars of a histogram.	
Hypotenuse	The side opposite the right-angle in a right-angled triangle. It is also the longest side in a right-angled triangle.	
Indirect Proportion (Inverse Proportion)	As one quantity increases the other decreases, or as one quantity decreases the other increases. The product of the quantities always remains the same.	It takes 10 painters 2 days to paint a house. The product is 20. If there were 5 painters the product must remain 20. This means it would take 5 painters 4 days to paint the same house.
Isosceles triangle	A triangle which has two equal sides. The angles at the bases of the equal sides are also equal.	
Lower Quartile (Q_1)	The lower quartile is the median of the lower half. It divides the lower half of a data set in half.	The lower quartile of the data set 0 ; 2; 4; 6; 8; 10 ; 12 is 2. (the median is 6)
Mean ($\bar{x}$)	The average value of a data set. It is calculated by adding all of the numbers in the set and dividing by the total number of elements in the set.	The mean of the set 2; 3; 4 and 7 is: $\frac{2+3+4+7}{4}=4$
Median	The middle value of an ordered data set.	The median of the set 2; 4; 6; 8; 10 is 6.

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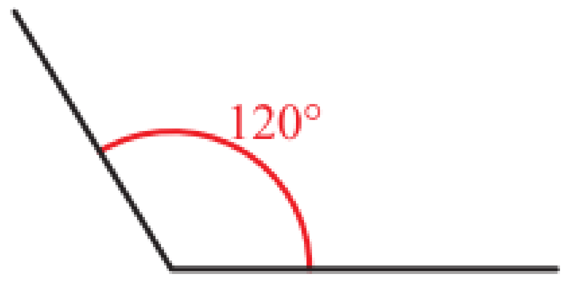
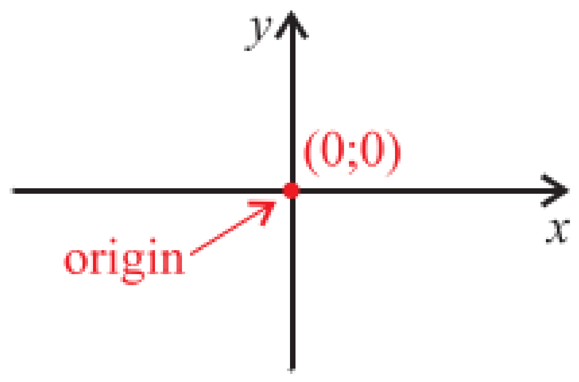
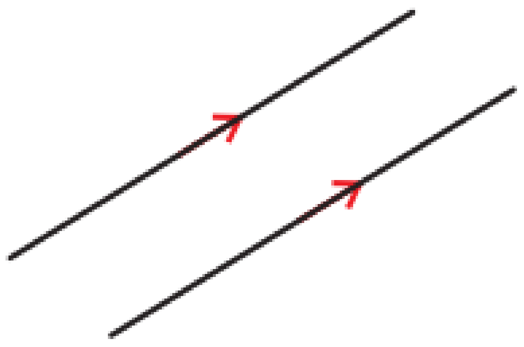
Term	Explanation	Example (where possible)
Mode	The value in a data set which occurs most often.	The mode of the set 2; 3; 9; 3; 3 is 3.
Monomial	An expression which only has one term.	The expression x is a monomial.
Multiplicative inverse	The multiplicative inverse of a number is its reciprocal. When a number is multiplied by its multiplicative inverse (reciprocal) the answer is 1.	The multiplicative inverse of 2 is $\frac{1}{2}$.
Numerator	The number or expression at the top of a fraction.	In the fraction $\frac{3}{x}$ The numerator is 3.
Obtuse angle	An angle that is greater than 90° and less than 180°.	
Origin	The point where the x and y-axes meet. The coordinates of the origin are always (0;0).	
Parallel lines (//)	Lines which are parallel never intersect or touch each other. Train tracks and power lines are examples of parallel lines.	

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Term	Explanation	Example (where possible)
Upper Quartile (Q_3)	The upper quartile is the median of the upper half. It divides the upper half of a data set in half.	The upper quartile of the data set 0 ; 2; 4; 6; 8; 10 ; 12 is 2. (the median is 6)

GLOSSARY OF IMPORTANT SYMBOLS

Symbol	Meaning	Symbol	Meaning
$\sqrt{\ }$	square root	$\in$	element (of a set)
$\sqrt[n]{\ }$	n^{th} root	$\neq$	not equal to
$\mathbb{N}$	natural numbers	$\approx$	approximately equal to
$\mathbb{N}_0$	whole numbers	$A > B$	A is greater than B
$\mathbb{Z}$	integers	$A < B$	A is less than B
$\mathbb{Q}$	rational numbers	$A \geq B$	A is greater than or equal to B
$\mathbb{Q}'$	irrational numbers	$A \leq B$	A is less than or equal to B
$\mathbb{R}$	real numbers	$\therefore$	therefore

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MATHS HANDBOOK and STUDY GUIDE™

EXERCISES & SOLUTIONS

The exercises contained in this section are designed for reinforcement of the material covered in each chapter of the book. At the end of the exercises for each relevant chapter, learners will find a mixed exercise. The mixed exercises are designed to test all of the work in the relevant chapters and are of the same standard that learners would expect to find in a test or exam. Learners are strongly encouraged to make sure that they fully understand all questions within the mixed exercises.

The exercises in this section contain worked through solutions. These are merely suggested solutions and are not necessarily the only methods that can be used to arrive at a correct answer. If there is any doubt in the method which learners have used, they are encouraged to check their methodology with their teachers.

Worked through solutions are provided in order for learners to check their answers and understand errors which they have made. Very little will be gained from viewing solutions before an attempt has been made by the learner to solve the problems themselves. Learners should only look at solutions after a true attempt of the problem has been made.

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Chapter 1–The Number System, Proportion, Rate and Financial Mathematics

The Number System (from pages 3 and 4)

Exercise 1:

1) Examine the numbers in the table below, state which of the numbers are:

-7	125	$\sqrt{12}$	$0{,}125$	$\frac{16}{2}$	$-\frac{18}{3}$	$\sqrt{\frac{1}{36}}$	0	10	$-\sqrt{24}$

a) Natural numbers
b) Whole numbers
c) Integers
d) Rational numbers
e) Irrational numbers

Solutions to Exercise 1 number 1 are on page **254**

2) Complete the table below. The first row has been completed for you.

	$\mathbb{N}$	$\mathbb{N}_0$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{Q}'$
8	✓	✓	✓	✓	
2,35					
$\frac{4}{5}$					
–4,55					
$2{,}\dot{8}$					
π					
$\sqrt{3}$					
$\sqrt{4}$					
$\sqrt{8}$					
$\sqrt[3]{27}$					
3π					
$\frac{22}{7}$					

Solutions to Exercise 1 number 2 are on page **254**

Grade 8 Revision (from pages 5-10)

Exercise 2:

1) A truck travels at an average speed of 70km/h.

a) If the truck travels a distance of 420km from Johannesburg to Pietermaritzburg, how long will the journey take?

b) What speed would the truck have to travel at to make the journey in 3 hours?

Solutions to Exercise 2 number 1 are on page **254**

2) In a cycling race a cyclist travels a distance of 80km in 2 hours and 30 minutes.

a) What was the cyclist's average speed?

b) What speed would the cyclist have to travel at in order to complete the race in 1 hour and 48 minutes?

Solutions to Exercise 2 number 2 are on page **254**

3) A car manufacturer claims that its car has an average fuel consumption of 7,5*l*/100km.

a) What does *l*/100km stand for?

b) What is the maximum distance the car can travel if its petrol tank can hold 54 litres?

c) How many litres of petrol would be needed to travel 250km?

d) A motorist fills the petrol tank and travels a distance of 675km before the tank is empty. What is the cars actual fuel consumption? Give your answer in *l*/100km.

Solutions to Exercise 2 number 3 are on page **254**

4) The table below shows distances between various places in South Africa. If a car travels at an average speed of 90 km/h for 18 hours, which two locations did the car travel between?

Locations	Distance (km)	Locations	Distance (km)
Aliwal North to Amanzimtoti	610	Durban to Cape Town	1 600
Grahamstown to Johannesburg	966	Johannesburg to Umtata	851
Kimberly to Johannesburg	475	Skukuza to Durban	814
Komatipoort to Cape Town	1844	Durban to Richards Bay	172

Solutions to Exercise 2 number 4 are on page **255**

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Direct and Indirect Proportion (from pages 11-13)

Exercise 3:

1) A builder works 4,5 days a week and earns R24 000 per month. How much would he earn if he worked 6 days per week?

Solutions to Exercise 3 number 1 are on page 255

2) A cleaning product has instructions that for every 3 litres of water, it must be diluted in 1,5 litres of cleaning agent. How many litres of water would be required if 500ml of cleaning agent is used?

Solutions to Exercise 3 number 2 are on page 255

3) In order to make coffee for 2 people, 500 ml of water, 2 teaspoons of coffee and 4 teaspoons of sugar are used.

a) How much water would be needed to make 9 cups of coffee?
b) How much coffee would be needed to make 7 cups of coffee?
c) How much sugar is needed for 12 cups of coffee?

Solutions to Exercise 3 number 3 are on page 255

4) A certain book consists of 200 sheets of paper. If 8 sheets of paper have a mass of 64g:

a) What is the mass of a single book? Give your answer in kilograms.
b) The cost of shipping 5 books to a store is R7,50. What is the cost of shipping 17 books?

Solutions to Exercise 3 number 4 are on page 255

5) In order to make green paint 4,5 litres of white paint is mixed with 20ml of green pigment. If 70ml of green pigment is used, how many litres of white paint are required?

Solutions to Exercise 3 number 5 are on page 256

6) A car's fuel tank can hold a maximum of 50 litres of petrol. The low petrol warning light turns on when there are 10 litres of petrol remaining in the tank. If 33 litres of petrol costs R377,85, how much would it cost to fill the tank straight after the petrol warning light turns on?

Solutions to Exercise 3 number 7 are on page 256

Exercise 4:

1) It takes a team of 3 painters 22 days to paint a house.

a) How long would it take 10 painters to paint the same house?
b) How many painters would be needed in order to paint the same house in 11 days?

Solutions to Exercise 4 number 1 are on page 256

2) A journey by a car travelling at an average speed of 72 km/h takes 3 hours.

a) If the car travelled at an average speed of 80km/h how long would the journey take?
b) How fast would the car have to travel to complete the journey in 2 hours and 15 minutes?

Solutions to Exercise 4 number 2 are on page 256

3) A team of 3 workers takes 12 days to dig a trench 3 metres wide and 30 metres long.

a) How long would it take 4 workers to dig the same trench?
b) How many workers would be needed to dig the trench in 6 days?

Solutions to Exercise 4 number 3 are on page 256

Financial Mathematics (from pages 14-19)

Exercise 5:

1) Chadd and Shei are two naughty brothers who broke their mother's large window while playing cricket inside the house. In order to pay for the window, they take out a loan from their father for R2 500 at a simple interest rate of 12,5% per annum.

a) How much will Chadd and Shei pay in total for the window if the loan is to be paid back over 3 years?
b) How much interest is paid on the loan?

Solutions to Exercise 5 number 1 are on page 257

2) Lerato takes out a loan of R12 800 at a simple interest rate of 9,5% p.a. in order to purchase a piano. The loan has to be paid back in full at the end of 5 years.

a) How much will Lerato actually pay?
b) How much interest will Lerato pay on the loan?

Solutions to Exercise 5 number 2 are on page 257

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3) Ariel would also like to purchase a piano for R12 800 and is offered an interest rate of 8% p.a. on a hire purchase agreement. The terms of the loan are that a 5% cash deposit is paid initially and that the loan is paid back monthly over a period of 4 years.

a) What is the cash deposit that has to be paid?
b) How much will Ariel have to pay over the 4 years?
c) What are the monthly payments which Ariel will have to make?
d) What is the total amount that Ariel pays for the piano?

Solutions to Exercise 5 number 3 are on page **257**

4) Preshay purchases a dishwasher for R7 800 on a hire purchase agreement. The agreement states that the loan is to be paid back monthly over a period of 3 years at a simple interest rate of 10% p.a. and a 12,5% cash deposit is to be paid upfront.

a) How much is the cash deposit that has to be paid?
b) How much will Preshay have to pay over the 3 years?
c) What are the monthly payments which Preshay will have to make?
d) What is the total amount that Preshay will pay for the dishwasher?

Solutions to Exercise 5 number 4 are on page **257**

5) Kerry and Gina are two sisters that would like to start a DJ business. They purchase the sound equipment on a hire purchase agreement. The agreement stipulates that an 18% cash deposit is paid upfront and the remainder of the loan is paid back in equal monthly instalments over a period of 8 years at an interest rate of 11% p.a. simple interest. If the cash price of the sound equipment is R25 000, what are the monthly instalments which Kerry and Gina will have to make?

Solutions to Exercise 5 number 5 are on page **257**

Exercise 6:

1) Mrs Ndlovu invests R5 200 into a savings account which offers an interest rate of 5,5% p.a compounded annually. How much will Mrs Ndlovu have in her account at the end of 9 years?

Solutions to Exercise 6 number 1 are on page **257**

2) In order to save for his child's 1st year at university, Mr Dasoo invests R10 000 at interest rate of 10% p.a. compounded annually. He invests the money when his child starts Grade 8. How much will he have saved by the time his child starts 1st year university.

Solutions to Exercise 6 number 2 are on page **257**

3) Mr Jeffries takes out a loan of R18 000 at interest rate of 12,5% p.a. compounded annually. If The loan is paid back at the end of 7 years, how much will Mr Jeffries have to pay?

Solutions to Exercise 6 number 3 are on page **257**

4) An investment of R6 700 earns interest at a rate of 8,5% p.a. compounded annually. How much will the investment be worth at the end of 10 years?

Solutions to Exercise 6 number 3 are on page **257**

5) Simon invests R8 000 into a savings account that offers an interest rate of 10% p.a. compounded annually.

a) How much will Simon have in his account at the end of 10 years?
b) At the end of 10 years Simon withdraws the money in his account and loans it to a friend at an interest rate of 10,5% p.a. compounded annually. How much will Simon receive if the loan is for 4 years?

Solutions to Exercise 6 number 3 are on page **258**

Mixed Exercise:

1) Examine the list of numbers given in the table below:

$\frac{3}{7}$	$0,\dot{2}$	$-\left(\sqrt{8}\right)^2$	$2,127\ldots$	$\sqrt{81}$	$-5,3$	$\sqrt{64-49}$	$5+\pi$	0	$\sqrt[3]{-27}$

From the table above, write down the:

a) Natural numbers
b) Whole numbers
c) Integers
d) Rational numbers
e) Irrational numbers

Solutions to the Mixed Exercise number 1 are on page **258**

2) Given the numbers 36, 60 and 72:

a) Write the numbers as a product of their prime factors.
b) Determine the HCF of the numbers.
c) Determine the LCM of the numbers.

Solutions to the Mixed Exercise number 2 are on page **258**

3) The product of 3 prime numbers is 66. What is the sum of the numbers?

Solutions to the Mixed Exercise number 3 are on page **258**

4) Jamie has a piggy bank in which she saves all of her R5, R2 and R1 coins. The coins are in a ratio of 2:5:7 respectively.

a) If she has twelve R5 coins saved in her piggy bank. How much has she saved?
b) If she has R70 in R2 coins, how many R5, R2 and R1 coins has she saved?

Solutions to the Mixed Exercise number 4 are on page **258**

5) Henry's hair grows at rate of 1,2 cm per month. He shaves his head and decides not to cut his hair for 8 years. How long will his hair be at the end of 8 years?

Solutions to the Mixed Exercise number 5 are on page **259**

6) Jack walked up a hill to fill his bucket with water. Unfortunately, Jack's bucket has a hole in it which leaks water at a rate of 0,25 litres per minute. If Jack's bucket has a capacity of 5 litres, how much water will be left in the bucket if it takes Jack 14 minutes and 30 seconds to walk down the hill?

Solutions to the Mixed Exercise number 6 are on page **259**

7) On the road from Johannesburg to Durban, average speed cameras are used to enforce the speed limit of 120km/h. The system works by using two cameras, 80 km apart, to read a car's number plate and calculate its average speed. If the first camera takes a picture of a car's number plate at 08:40 and the second camera takes a picture of the same car at 9:16, will the motorist receive a speeding ticket?

Solutions to the Mixed Exercise number 7 are on page **259**

8) A tiler charges R1 250 to tile an area of 12,5 square metres.

a) How much would it cost to tile an area of 36 square metres?
b) What area could be tiled for R18 000?

Solutions to the Mixed Exercise number 8 are on page **259**

9) A farmer hires 110 workers to harvest apples from his trees. It takes the workers 12 days to harvest the farmers entire crop.

a) How long would it take 440 workers to harvest the crop?
b) The farmer needs his crop to be harvested in 18 days or less. What is the minimum number of workers needed to complete the job?

Solutions to the Mixed Exercise number 9 are on page **259**

10) Examine table A and B below:

Table A:

P	3	6	1536	21
Q	9	18	4608	x

Table B:

R	2	10	12,5	y
S	25	5	4	6,25

a) Are P and Q directly or inversely proportional? Give a reason for your answer.
b) Are R and S directly or inversely proportional? Give a reason for your answer.
c) Determine the values of x and y.

Solutions to the Mixed Exercise number 10 are on page **259**

11) Thabo decides to buy a new lounge suite worth R30 000. The store offers him the following hire-purchase agreement: A deposit of 10% now and 12% p.a. simple interest over 3 years.

a) Calculate the amount of money Thabo still owes once he has paid the deposit.
b) Calculate the monthly repayment over the three years.
c) What amount of money would Thabo have saved if he had paid the original cash price?

Solutions to the Mixed Exercise number 11 are on page **260**

12) Siphiwe invests R5 000 into a savings account that offers an interest rate of 8,5% compounded annually. John invests R1 000 into a savings account at an unknown interest rate. The table below shows the value of John's investment over a period of 5 years.

Years	0	1	2	3	4	5
Investment value	R1000	R1100	R1200	R1300	R1400	R1500

a) Does John's investment earn simple or compound interest? Give a reason for your answer.
b) What interest rate did John receive?
c) Calculate the amount that Siphiwe and John will have in their accounts at the end of 12 years.

Solutions to the Mixed Exercise number 12 are on page **260**

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Chapter 1–The Number System, Ratio, Rate and Financial Mathematics (Solutions)

Exercise 1 Solutions:

1)

a) $125; \frac{16}{2}; 10$

b) $125; \frac{16}{2}; 0; 10$

c) $-7; 125; \frac{16}{2}; 0; 10; -\frac{18}{3}$

d) $-7; 125; 0{,}125; \frac{16}{2}; -\frac{18}{3}; \sqrt{\frac{1}{36}}; 0; 10$

e) $\sqrt{12}; -\sqrt{24}$

Exercise 1 number 1 is on page 250

2)

	$\mathbb{N}$	$\mathbb{N}_0$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{Q}'$
8	✓	✓	✓	✓	
2,35				✓	
$\frac{4}{5}$				✓	
–4,55				✓	
$2,\dot{8}$				✓	
π					✓
$\sqrt{3}$					✓
$\sqrt{4}$	✓	✓	✓	✓	
$\sqrt{8}$					✓
$\sqrt[3]{27}$	✓	✓	✓	✓	
3π					✓
$\frac{22}{7}$				✓	

Exercise 1 number 2 is on page 250

Exercise 2 Solutions:

1)

a)
$$\begin{aligned} \text{time} &= \frac{\text{distance}}{\text{speed}} \\ &= \frac{420}{70} \\ &= 6 \text{ hours} \end{aligned}$$

b)
$$\begin{aligned} \text{speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{420}{3} \\ &= 140 \text{ km/h} \end{aligned}$$

Exercise 2 number 1 is on page 250

2)

a)
$$\begin{aligned} \text{speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{80}{2{,}5} \\ &= 32 \text{ km/h} \end{aligned}$$

b)
$$\begin{aligned} \text{speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{80}{1{,}8} \\ &= 44{,}44 \text{ km/h} \end{aligned}$$

Exercise 2 number 2 is on page 250

3) It is important to take into account that the consumption is per hundred kilometres not per kilometre:

a) Litres per hundred kilometres.

b)
$$\begin{aligned} \text{distance} &= \frac{54}{7{,}5} \times 100 \\ &= 720 \text{ km} \end{aligned}$$

c)
$$\begin{aligned} \text{litres of petrol} &= \frac{250}{100} \times 7{,}5 \\ &= 18{,}75 \text{ litres} \end{aligned}$$

d)
$$\begin{aligned} \text{consumption} &= \frac{54}{6{,}75} \\ &= 8\ l/100\text{km} \end{aligned}$$

Exercise 2 number 3 is on page 250

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4) $\text{distance} = \text{speed} \times \text{time}$

$$= 90 \times 18$$
$$= 1620\,\text{km}$$

Therefore, he must have travelled between Durban and Cape Town.

Exercise 2 number 4 is on page **250**

Exercise 3 Solutions:

1)

Salary	Days
x	6
24 000	4,5

$$\frac{x}{24\,000} = \frac{6}{4,5}$$

$$\therefore x = \frac{6}{4,5} \times 24\,000$$
$$= \text{R}32\,000 \text{ per month}$$

Exercise 3 number 1 is on page **251**

2) It is important to note that you can only work in one unit. In other words you have to either work in millilitres(ml) or litres. There are 1000ml in 1 litre. To convert millilitres to litres you divide by 1000.

Water	Agent
x	0,5
3	1,5

$$\frac{x}{3} = \frac{0,5}{1,5}$$

$$\therefore x = \frac{0,5}{1,5} \times 3$$
$$= 1 \text{ litre of water}$$

Exercise 3 number 2 is on page **251**

3)

a)

Water	Cups
x	9
500	2

$$\frac{x}{500} = \frac{9}{2}$$

$$\therefore x = \frac{9}{2} \times 500$$
$$= 2\,250 \text{ ml of water}$$

b)

Coffee	Cups
x	7
2	2

$$\frac{x}{2} = \frac{7}{2}$$

$$\therefore x = \frac{7}{2} \times 2$$
$$= 7 \text{ teaspoons}$$

c)

Sugar	Cups
x	12
4	2

$$\frac{x}{4} = \frac{12}{2}$$

$$\therefore x = \frac{12}{2} \times 4$$
$$= 24 \text{ teaspoons}$$

Exercise 3 number 3 is on page **251**

4) In this question it is important to note that there are 1000g in 1 kg. To convert grams to kilograms divide by 1000.

a)

Mass	Sheets
x	200
64	8

$$\frac{x}{64} = \frac{200}{8}$$

$$\therefore x = \frac{200}{8} \times 64$$
$$= 1600\text{g}$$

$\therefore$ 1 book has a mass of 1,6 kg

b)

Cost	Number of Books
x	17
7,5	5

$$\frac{x}{7,5} = \frac{17}{5}$$

$$\therefore x = \frac{17}{5} \times 7,5$$
$$= \text{R}25,50$$

Exercise 3 number 4 is on page **251**

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5)

Paint	Pigment
x	70
4,5	20

$$\frac{x}{4,5}=\frac{70}{20}$$

$$\therefore x=\frac{70}{20}\times 4,5$$

$$=15,75\text{ ml of paint}$$

Exercise 3 number 5 is on page **251**

6)

Cost	Litres
x	40
377,85	33

$$\frac{x}{377,85}=\frac{40}{33}$$

$$\therefore x=\frac{40}{33}\times 377,85$$

$$=\text{R}458$$

Exercise 3 number 6 is on page **251**

Exercise 4 Solutions:

1)

a)

Days	Painters
x	10
22	3

$$10x=(22)(3)$$

$$\therefore x=\frac{(22)(3)}{10}$$

$$=6,6\text{ days}$$

b)

Painters	Days
x	11
3	22

$$11x=(3)(22)$$

$$\therefore x=\frac{(3)(22)}{11}$$

$$=6\text{ painters}$$

Exercise 4 number 1 is on page **251**

2)

a)

Time	Speed
x	80
3	72

$$80x=(72)(3)$$

$$\therefore x=\frac{(72)(3)}{80}$$

$$=2,7\text{ hours}$$

=2 hours and 42 minutes

b)

Speed	Time
x	2,25
72	3

$$2,25x=(3)(72)$$

$$\therefore x=\frac{(3)(72)}{2,25}$$

$$=96\text{ km/h}$$

Exercise 4 number 2 is on page **251**

3)

a)

Days	Workers
x	4
12	3

$$4x=(3)(12)$$

$$\therefore x=\frac{(3)(12)}{4}$$

$$=9\text{ days}$$

b)

Workers	Days
x	6
3	12

$$6x=(12)(3)$$

$$\therefore x=\frac{(12)(3)}{6}$$

$$=6\text{ workers}$$

Exercise 4 number 3 is on page **251**

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Exercise 5 Solutions:

1)

a) $A = P(1+in)$

$= 2500[1+0{,}125(3)]$

$= R3437{,}50$

b) $\text{Interest} = 3437{,}50 - 2500$

$= 3437{,}50 - 2500$

$= R937{,}50$

Exercise 5 number 1 is on page **251**

2)

a) $A = P(1+in)$

$= 12800[1+0{,}095(5)]$

$= R18880$

b) $\text{Interest} = 3437{,}50 - 2500$

$= 18880 - 12800$

$= R6080$

Exercise 5 number 2 is on page **251**

3)

a) $\text{Deposit} = 12800 \times 0{,}05$

$= R640$

b) $A = P(1+in)$

$= 12160[1+0{,}08(4)]$

$= R16051{,}20$

c) $\text{Payments} = \dfrac{16051{,}20}{48}$

$= R334{,}40$

d) $\text{Total} = 640 + 16051{,}20$

$= R16691{,}20$

Exercise 5 number 3 is on page **252**

4)

a) $\text{Deposit} = 7800 \times 0{,}125$

$= R975$

b) $A = P(1+in)$

$= 6825[1+0{,}1(3)]$

$= R8872{,}50$

c) $\text{Payments} = \dfrac{8872{,}50}{36}$

$= R246{,}46$

d) $\text{Total} = 975 + 8872{,}50$

$= R9847{,}50$

Exercise 5 number 4 is on page **252**

5) $\text{Cash deposit} = 25000(0{,}18)$

$= R4500$

$\therefore \text{Loan amount} = 25000 - 4500$

$= R20500$

$A = P(1+in)$

$= 20500[1+0{,}11(8)]$

$= R38540$

$\text{Monthly payments} = \dfrac{38540}{8 \times 12}$

$= R401{,}46$

Exercise 5 number 5 is on page **252**

Exercise 6 Solutions:

1) $A = P(1+i)^n$

$= 5200(1+0{,}055)^9$

$= R8419{,}29$

Exercise 6 number 1 is on page **252**

2) $A = P(1+i)^n$

$= 10000(1+0{,}1)^5$

$= R16105{,}10$

Exercise 6 number 2 is on page **252**

3) $A = P(1+i)^n$

$= 18000(1+0{,}125)^7$

$= R41052{,}55$

Exercise 6 number 3 is on page **252**

4) $A = P(1+i)^n$

$= 6700(1+0{,}085)^{10}$

$= R15148{,}59$

Exercise 6 number 4 is on page **252**

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5)

a) $A = P(1+i)^n$

$= 8000(1+0,1)^{10}$

$= R20\,749,94$

b) $A = P(1+i)^n$

$= 20\,749,94(1+0,105)^4$

$= R30\,936,13$

Exercise 6 number 5 is on page **252**

<u>Mixed Exercise Solutions</u>:

1)

a) $\sqrt{81}$

b) $\sqrt{81};0$

c) $-\left(\sqrt{8}\right)^2;\sqrt{81};0;\sqrt[3]{-27}$

d) $\frac{3}{7};0,\dot{2};-\left(\sqrt{8}\right)^2;\sqrt{81};-5,3;0;\sqrt[3]{-27}$

e) $2,127...;\sqrt{64-49};5+\pi$

The Mixed Exercise number 1 is on page **252**

2)

a)

2	36
2	18
3	9
3	3
	1

2	60
2	30
3	15
5	5
	1

2	72
2	36
2	18
3	9
3	3
	1

$36 = 2^2 \times 3^2$ $\quad 60 = 2^2 \times 3 \times 5$ $\quad 72 = 2^3 \times 3^2$

b) $\text{HCF} = 2^2 \times 3 = 12$

c) $\text{LCM} = 2^3 \times 3^2 \times 5 = 360$

The Mixed Exercise number 2 is on page **253**

3)

2	66
3	33
11	11
	1

$\therefore \text{sum} = 2+3+11$

$= 16$

The Mixed Exercise number 3 is on page **253**

4)

a) $1 \text{ part} = \frac{12}{2}$

$= 6$

$\therefore\ 5 \text{ parts} = 5 \times 6$ $\qquad 7 \text{ parts} = 6 \times 7$

$= 30$ $\qquad = 42$

$\therefore$ There are twelve R5 coins thirty R2 coins and forty-two R1 coins

$\therefore \text{Total saved} = 12 \times 5 + 30 \times 2 + 42 \times 1$

$= R162$

b) Number of R2 coins $= 70 \div 2$

$= 35$

$\therefore 1 \text{ part} = \frac{35}{5}$

$= 7$

$\therefore\ 2 \text{ parts} = 7 \times 2$ and $7 \text{ parts} = 7 \times 7$

$= 14$ $\qquad = 49$

$\therefore$ There are fourteen R5 coins thirty five R2 coins and forty-nine R1 coins

The Mixed Exercise number 4 is on page **253**

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5) $\text{Length} = 1,2 \times 8 \times 12$
$= 115,2\,\text{cm long}$

The Mixed Exercise number 5 is on page **253**

6) $\text{Volume of water leaked} = 0,25 \times 14,5$
$= 3,625\,\text{litres}$

$\therefore$ Water remaining in the bucket $= 5 - 3,625$
$= 1,375\,\text{litres}$

The Mixed Exercise number 6 is on page **253**

7) Time between cameras = 36 minutes
= 0,6 hours

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$
$$= \frac{80}{0,6}$$
$$= 133,33\,\text{km/h}$$

$\therefore$ The motorist is speeding and will receive a ticket.

The Mixed Exercise number 7 is on page **253**

8) This is an example of direct proportion:

a)

Cost	Area
x	36
1 250	12,5

$$\frac{x}{1250} = \frac{36}{12,5}$$
$$\therefore x = \text{R}3600$$

b)

Area	Cost
x	18 000
12,5	1 250

$$\frac{x}{12,5} = \frac{18000}{1250}$$
$$\therefore x = 180\,\text{m}^2$$

The Mixed Exercise number 8 is on page **253**

9) This is an example of inverse proportion:

a)

Days	Workers
x	440
12	110

$$440x = 12(110)$$
$$\therefore x = 3 \text{ days}$$

b)

Workers	Days
x	18
110	12

$18x = 12(110)$

$\therefore x = 73,33$ workers

$\therefore$ At least 74 workers are required to complete the harvest in less than 18 days

The Mixed Exercise number 9 is on page **253**

10)

a) Directly proportional. The ratio between the variables is constant. $\left(\frac{9}{3} = \frac{18}{6} = \frac{4608}{1536} = 3\right)$

b) Inversely proportional. The product of the variables is constant. $(25 \times 2 = 10 \times 5 = 12,5 \times 4 = 50)$

c) $\frac{x}{21} = 3$ and $6,25y = 50$

$\therefore x = 21 \times 3$ and $y = \frac{50}{6,25}$

$\therefore x = 63$ and $y = 8$

The Mixed Exercise number 10 is on page **253**

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11)

a) Deposit $= 30\,000 \times 0{,}1$

$= R3\,000$

Loan amount $= 30\,000 - 3\,000$

$= R27\,000$

b) $A = P(1+in)$

$= 27\,000[1+(0{,}12)(3)]$

$= R36\,720$

Monthly repayments $= \dfrac{36\,720}{36}$

$= R1020$ per month

c) Saving $= (\text{loan amount} + \text{deposit}) - \text{cash price}$

$= (36\,720 + 3000) - 30\,000$

$= R9\,720$

The Mixed Exercise number 11 is on page **253**

12)

a) Simple interest. The same amount of interest is earned each year. This means that interest is earned on the initial investment not on the amount in the account at the end of each year.

b) John's initial investment was R1000. He earned R100 interest on this investment each year. This is an interest rate of 10% p.a.

c) Siphiwe:

$A = P(1+i)^n$

$= 5\,000(1+0{,}085)^{12}$

$= R13\,308{,}43$

John:

$A = P(1+in)$

$= 1000[1+(0{,}1)(12)]$

$= R2\,200$

The Mixed Exercise number 12 is on page **253**

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Chapter 2–Integers

Integers (from pages 21 - 26)

Mixed Exercise:

1) Arrange the following Integers in ascending (smallest to biggest) order:

a) 10; –10; –8; 2; –7; 6

b) 12; –8; –9; –12; 4; 3

Solutions to the Mixed Exercise number 1 are on page **263**

2) Arrange the following Integers in descending (largest to smallest) order:

a) –6; –1; –8; 21; 6; –3; –11

b) –8; –1; 8; –16; 12; –12; 9

Solutions to the Mixed Exercise number 2 are on page **263**

3) Write down all the integers:

a) Greater than –5 but smaller than or equal to 2.

b) Smaller than –5 but greater then –8.

c) Greater than –11 but less than –3.

d) Greater than –9 and smaller –5.

Solutions to the Mixed Exercise number 3 are on page **263**

4) Answer the following questions:

a) On a cold winters day in Chicago the temperature is –16°C. The wind chill factor lowers the real feeling of the air temperature by 4°C, what does the air temperature feel like?

b) On a winter's evening, the temperature in Gauteng is 4ºC. On the same evening the temperature in Sutherland (South Africa's coldest town) is –8°C. How much warmer is Gauteng than Sutherland on that evening?

c) The average temperature on the summit of Mount Everest in summer is –19°C and in winter it is –36°C. How much colder is it at the summit of Mount Everest in winter compared to summer.

Solutions to the Mixed Exercise number 4 are on page **263**

5) Each of the integers below is increased by 4. Write down the resulting integer after the increase.

a) –6

b) –3

c) –4

d) –12

e) 4

f) –18

Solutions to the Mixed Exercise number 5 are on page **263**

6) Each of the integers below is decreased by 4. Write down the resulting integer after the decrease.

a) –6

b) –3

e) –4

f) –12

g) 4

h) –18

Solutions to the Mixed Exercise number 6 are on page **263**

7) Without the use of a calculator, determine the value of:

a) $2(-3)+6-(-1)$

b) $-2+(-4)(-2)-3$

c) $-(-4)-6+(0)(-100)$

d) $-3-2+(-3)-2$

e) $-2-4+(-2)(-1)$

f) $-2(-5-2)+3(-2-3)$

g) $-2-2(-2)2$

h) $\dfrac{-16-6(6)}{-10-3}$

i) $\dfrac{-3(-8)+8+(-2)}{9(-3)-3}$

j) $\dfrac{8(2)-16}{(5413)(35487)(987452)}$

k) $\dfrac{-2+9-18(2)-3}{8-8}$

l) $\dfrac{3(5)-4\times-3+3\times2+3}{18\div3}$

m) $\dfrac{-(-2)-(-4)+2-2(2)}{2(2)}$

n) $\dfrac{-2(1)+8}{-2}+3$

o) $\dfrac{-2(2+1)-4(2)}{-2+9}$

p) $\dfrac{-6+3(-3)1+3}{-3-3}$

q) $\dfrac{-2(-4)+2\times3}{1+2\times3}$

r) $\dfrac{-4+(8-4)-(4)2}{-2\times2}$

s) $\dfrac{-3(2)+8(2)-12(2)}{-3(2)+8(-2)-12(-2)}$

t) $\dfrac{-3+2\times-2-3-2}{-2+3\times2}$

u) $\dfrac{-2(3)+4(-1)+2-10}{10(2)-17-3}$

Solutions to the Mixed Exercise number 7*a* to *o* are on page **263** and *p* to *u* are on page **264**

8) Insert brackets to make the following statements true:

a) $10 + 8 \div -4 \times 2 = 6$

b) $12 + 9 \div -3 \times 2 = -14$

c) $12 \times 3 \div -16 \div 4 = -9$

d) $8 \div 2 \times 4 + 5 - 3 \times 2 = 5$

e) $8 \div 2 \times 4 + 5 - 3 \times 2 = 0$

f) $-4 - 3 \times -3 - 2 = 11$

g) $3 \div 4 \times 5 - 17 = 1$

h) $8 \div 2 \times 4 - 4 = 0$

Solutions to the Mixed Exercise number 8 are on page **264**

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9) Simplify the following:

a) $-x + 4x - 3 - 4x + 2^2$

b) $-6 + 7x - 9x - 3^2 + 11$

c) $3x^3 - 10x - 12x + 6x^3$

d) $-3x^2 + 5x - 2x - 2x^2$

e) $-5x^2 + 2x - 3x - 4x^2$

f) $2x - 3x^2 - 5x - x + 5x^2$

g) $2x^3 - 3x^2 - 5 - 4x^3 - 9x^2 + 6x + 2$

h) $5x^4 - 2x^2 - 5 + 2x^4 - 8 + 2x - 3$

i) $3a^4 - 2b^2 - 5 + 2a^4 - 8 + 2b - 3$

j) $5x^2y - 2x^2 - 5xy^2 + 2yx^2 - 8x^2 + 2y^2x - 3$

k) $2y^2 - 5y - 4 + y^2 - 3y - 2 + 4y^2 - y - 1$

l) $2p^2 - p - 8 - 3p^2 + 4p - 1 - 2p^2 - 2p + 2$

m) $3q^2 - (-q) - 2 + 2q^2 - 4q - 2 + q^2 - q - (-2)$

n) $5r^2 + (-2r) + 1 - 3r^2 - r - 1 + 2r^2 - 2r - (-5)$

o) $8c^2 - c - 2 - 2c^2 + (-4c) - 3c^2 - (2c) + 5c$

p) $2z^3 - (-5z) + 5 - 4z^3 + z + 5 - 10z - z^2 - (-3)$

Solutions to the Mixed Exercise number 9 are on page **264**

10) Simplify the following:

a) $(-x)(-3x)$

b) $(-x)+(-3x)$

c) $(2x)(-3x)$

d) $(-2x)(3x)$

e) $(2x)+(-3x)$

f) $(2x)-(-3x)$

g) $5x^2\left(5x^2\right)$

h) $5x^2+5x^2$

i) $-5a-\left(-2a^2\right)$

j) $-5a\left(-2a^2\right)$

k) $-3x^2\left(-2x^2\right)$

l) $-3x^2+\left(-2x^2\right)$

m) $-3x^2\left(-2x^2\right)(-x)$

n) $-3x^2\times(-2y)$

o) $-x^2y-2x(-x)(-y)$

p) $a^2b(3a)-2ba^3$

Solutions to the Mixed Exercise number 10 are on page **264**

11) Simplify the following:

a) $\dfrac{24xyz}{48xz}$

b) $\dfrac{-10x^2}{x^2y}$

c) $\dfrac{-2a^3b^2}{4a^2}$

d) $\dfrac{-18x^4y^6}{9x^3y}$

e) $\dfrac{6x^2-x^2}{x^2}$

f) $\dfrac{4a\left(4b^2\right)+6b(-2ab)}{4ab^2}$

Solutions to the Mixed Exercise number 11 are on page **265**

12) Simplify the following:

a) $4(2x)^2+5\left(2y^2\right)^3$

b) $\left(2p^2qr\right)^2+2p^4(-2qr)^2$

c) $\left(2a^2b\right)^2+3\left(a^2b\right)^2-x^2(-3ab)^2$

d) $\left(2n^2m\right)^3+2n^3m(3nm)^2-3n^3(-2nm)^3$

Solutions to the Mixed Exercise number 8 are on page **265**

13) Fill an integer variable into the blank space to make the following statements true:

a) $-3x+__=2x$

b) $__-4a+2a=-5a$

c) $-3z\times__=15z^2$

d) $__\div-5x=2$

e) $10x+__=28x$

f) $__\div3r=-9$

g) $10x\div__+1=2x+1$

h) $__\div2\times3x=30x$

Solutions to the Mixed Exercise number 13 are on page **265**

14) It is given that a ☯ $b=a^2-3b$. Evaluate the following:

a) $4x$ ☯ $2x^2$

b) $4x^3$ ☯ $\left(-2x^6\right)$

c) $x(2$ ☯ $-2)$ ☯ $-3x$

Solutions to the Mixed Exercise number 5 are on page **265**

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Chapter 2–Integers (Solutions)

Mixed Exercise Solutions:

1)

a) –10; –8; –7; 2; 6; 10

b) –12; –9; –8; 3; 4; 12

The Mixed Exercise number 1 is on page **261**

2)

a) 21; 6; –1; –3; –6; –8; –11

b) 12; 9; 8; –1; –8; –12; –16

The Mixed Exercise number 2 is on page **261**

3)

a) –4 ; –3 ; –2 ; –1 ; 0 ; 1

b) –6 ; –7

c) –10 ; –9 ; –8 ; –7 ; –6 ; –5 ; –4

d) –8 ; –7 ; –6

The Mixed Exercise number 3 is on page **261**

4)

a) –16 – 4
= –20°C

b) 4 – (–8)
= 12°C warmer

c) –19 – (–36)
=17°C colder

The Mixed Exercise number 4 is on page **261**

5)

a) – 6 + 4
= –2

b) –3 + 4
= 1

c) – 4 + 4
= 0

d) –12 + 4
= – 8

e) 4 + 4
= 8

f) –18 + 4
= – 14

The Mixed Exercise number 5 is on page **261**

6)

a) –6 – 4
= –10

b) –3 – 4
= –7

c) –4 – 4
= –8

d) –12 – 4
= –16

e) 4 – 4
= 0

f) –18 – 4
= –22

The Mixed Exercise number 6 is on page **261**

7)

a) $2(-3)+6-(-1)$
$=-6+6+1$
$=1$

b) $-2+(-4)(-2)-3$
$=-2+8-3$
$=3$

c) $-(-4)-6+(0)(-100)$
$=4-6+0$
$=-2$

d) $-3-2+(-3)-2$
$=-3-2-3-2$
$=-10$

e) $-2-4+(-2)(-1)$
$=-2-4+2$
$=-4$

f) $-2(-5-2)+3(-2-3)$
$=-2(-7)+3(-5)$
$=14-15$
$=-1$

g) $-2-2(-2)2$
$=-2-2(-4)$
$=-2+8$
$=6$

h) $\dfrac{-16-6(6)}{-10-3}$
$=\dfrac{-16-36}{-13}$
$=\dfrac{-52}{-13}$
$=4$

i) $\dfrac{-3(-8)+8+(-2)}{9(-3)-3}$
$=\dfrac{24+8-2}{-27-3}$
$=\dfrac{30}{-30}$
$=-1$

j) $\dfrac{8(2)-16}{(5413)(35487)(987452)}$
$=\dfrac{0}{(5413)(35487)(987452)}$
$=0$

k) $\dfrac{-2+9-18(2)-3}{8-8}$
$=\dfrac{-2+9-18(2)-3}{0}$
= undefined

l) $\dfrac{3(5)-4\times-3+3\times2+3}{18\div3}$
$=\dfrac{15+12+6+3}{6}$
$=6$

m) $\dfrac{-(-2)-(-4)+2-2(2)}{2(2)}$
$=\dfrac{2+4+2-4}{4}$
$=\dfrac{4}{4}$
$=1$

n) $\dfrac{-2(1)+8}{-2}+3$
$=\dfrac{-2+8}{-2}+3$
$=-3+3$
$=0$

o) $\dfrac{-2(2+1)-4(2)}{-2+9}$
$=\dfrac{-2(3)-8}{7}$
$=\dfrac{-14}{7}$
$=-2$

The Mixed Exercise number 7 is on page **261**

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p) $\frac{-6+3(-3)1+3}{-3-3}$

$=\frac{-6-9+3}{-6}$

$=\frac{-12}{-6}$

$=2$

q) $\frac{-2(-4)+2\times 3}{1+2\times 3}$

$=\frac{8+6}{1+6}$

$=2$

r) $\frac{-4+(8-4)-(4)2}{-2\times 2}$

$=\frac{-4+4-8}{-4}$

$=2$

s) $\frac{-3(2)+8(2)-12(2)}{-3(2)+8(-2)-12(-2)}$

$=\frac{-6+16-24}{-6-16+24}$

$==\frac{-14}{2}$

$=-7$

t) $\frac{-3+2\times -2-3-2}{-2+3\times 2}$

$=\frac{-3-4-3-2}{-2+6}$

$=\frac{-12}{4}$

$=-3$

u) $\frac{-2(3)+4(-1)+2-10}{10(2)-17-3}$

$=\frac{-6-4+2-10}{0}$

= undefined

The Mixed Exercise number 7 is on page **261**

8)

a) $10 + (8 \div -4) \times 2 = 6$

b) $(12 + 9) \div -3 \times 2 = -14$

c) $(12 \times 3) \div (-16 \div 4) = -9$

d) $8 \div (2 \times 4) + (5 - 3) \times 2 = 5$

e) $8 \div (2 \times 4) + 5 - 3 \times 2 = 0$

f) $-4 - 3 \times (-3 - 2) = 11$

g) $3 \div (4 \times 5 - 17) = 1$

h) $8 \div 2 \times (4 - 4) = 0$

The Mixed Exercise number 8 is on page **261**

9)

a) $-x + 4x - 3 - 4x + 2^2$
$= -x + 1$

b) $-6 + 7x - 9x - 3^2 + 11$
$= -2x - 4$

c) $3x^3 - 10x - 12x + 6x^3$
$= 9x^3 - 22x$

d) $-3x^2 + 5x - 2x - 2x^2$
$= -5x^2 + 3x$

e) $-5x^2 + 2x - 3x - 4x^2$
$= -9x^2 - x$

f) $2x - 3x^2 - 5x - x + 5x^2$
$= 2x^2 - 4x$

g) $2x^3 - 3x^2 - 5 - 4x^3 - 9x^2 + 6x + 2$
$= -2x^3 - 12x^2 + 6x - 3$

h) $5x^4 - 2x^2 - 5 + 2x^4 - 8 + 2x - 3$
$= 7x^4 - 2x^2 + 2x - 16$

i) $3a^4 - 2b^2 - 5 + 2a^4 - 8 + 2b - 3$
$= 5a^4 - 2b^2 + 2b - 16$

j) $5x^2y - 2x^2 - 5xy^2 + 2yx^2 - 8x^2 + 2y^2x - 3$
$= 7x^2y - 3xy^2 - 10x^2 - 3$

k) $2y^2 - 5y - 4 + y^2 - 3y - 2 + 4y^2 - y - 1$
$= 7y^2 - 9y - 7$

l) $2p^2 - p - 8 - 3p^2 + 4p - 1 - 2p^2 - 2p + 2$
$= -3p^2 + p - 7$

m) $3q^2 - (-q) - 2 + 2q^2 - 4q - 2 + q^2 - q - (-2)$
$= 6q^2 - 4q - 2$

n) $5r^2 + (-2r) + 1 - 3r^2 - r - 1 + 2r^2 - 2r - (-5)$
$= 4r^2 - 5r + 5$

o) $8c^2 - c - 2 - 2c^2 + (-4c) - 3c^2 - (2c) + 5c$
$= 3c^2 - 2c - 2$

p) $2z^3 - (-5z) + 5 - 4z^3 + z + 5 - 10z - z^2 - (-3)$
$= -2z^3 - z^2 - 4z + 13$

The Mixed Exercise number 9 is on page **262**

10)

a) $(-x)(-3x)$
$= 3x^2$

b) $(-x)+(-3x)$
$= -4x$

c) $(2x)(-3x)$
$= -6x^2$

d) $(-2x)(3x)$
$= -6x^2$

e) $(2x)+(-3x)$
$= -x$

f) $(2x)-(-3x)$
$= 5x$

g) $5x^2(5x^2)$
$= 25x^4$

h) $5x^2 + 5x^2$
$= 10x^2$

i) $-5a-(-2a^2)$
$= -5a + 2a^2$

j) $-5a(-2a^2)$
$= 10a^3$

k) $-3x^2(-2x^2)$
$= 6x^4$

l) $-3x^2 + (-2x^2)$
$= -5x^2$

m) $-3x^2(-2x^2)(-x)$
$= -6x^5$

n) $-3x^2 \times (-2y)$
$= 6x^2y$

o) $-x^2y - 2x(-x)(-y)$
$= -x^2y - 2x^2y$
$= -3x^2y$

p) $a^2b(3a) - 2ba^3$
$= a^3b$

The Mixed Exercise number 10 is on page **262**

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11)

a) $\frac{24xyz}{48xz}$

$=\frac{y}{2}$

b) $\frac{-10x^2}{x^2y}$

$=\frac{-10}{y}$

c) $\frac{-2a^3b^2}{4a^2}$

$=\frac{-ab^2}{2}$

d) $\frac{-18x^4y^6}{9x^3y}$

$-2xy^5$

e) $\frac{6x^2-x^2}{x^2}$

$=\frac{5x^2}{x^2}$

$=5$

f) $\frac{4a\left(4b^2\right)+6b(-2ab)}{4ab^2}$

$=\frac{16ab^2-12ab^2}{4ab^2}$

$=\frac{4ab^2}{ab^2}$

$=4$

The Mixed Exercise number 11 is on page **262**

12)

a) $4(2x)^2+5\left(2y^2\right)^3$

$=4\left(4x^2\right)+5\left(8y^6\right)$

$=16x^2+40y^6$

b) $\left(2p^2qr\right)^2+2p^4(-2qr)^2$

$=4p^4q^2r^2+2p^4\left(4q^2r^2\right)$

$=4p^4q^2r^2+8p^4q^2r^2$

$=12p^4q^2r^2$

c) $\left(2a^2b\right)^2+3\left(a^2b\right)^2-x^2(-3ab)^2$

$=4a^4b^2+3a^4b^2-x^29a^2b^2$

$=7a^4b^2-9a^2b^2x^2$

d) $\left(2n^2m\right)^3+2n^3m(3nm)^2-3n^3(-2nm)^3$

$=8n^6m^3+2n^3m\left(9n^2m^2\right)-3n^3\left(-8n^3m^3\right)$

$=8n^6m^3+18n^5m^3+24n^6m^3$

$=32n^6m^3+18n^5m^3$

The Mixed Exercise number 12 is on page **262**

13)

a) $-3x+\mathbf{5x}=2x$

b) $\mathbf{-3a}-4a+2a=-5a$

c) $-3z\times\mathbf{-5z}=15z^2$

d) $\mathbf{-10x}\div-5x=2$

e) $10x+\mathbf{18x}=28x$

f) $\mathbf{-27r}\div3r=-9$

g) $10x\div\mathbf{5}+1=2x+1$

h) $\mathbf{20}\div2\times3x=30x$

The Mixed Exercise number 12 is on page **262**

14)

a) $4x ☯ 2x^2$

$=(4x)^2-3\left(2x^2\right)$

$=16x^2-6x^2$

$=10x^2$

b) $4x^3 ☯ \left(-2x^6\right)$

$=\left(4x^3\right)^2-3\left(-2x^6\right)$

$=16x^6+6x^6$

$=22x^6$

c) $x(2 ☯ -2) ☯ -3x$

$=x\left[(2)^2-(-3[-2])\right] ☯ -3x$

$=x(4-6) ☯ -3x$

$=-2x ☯ -3x$

$=(-2x)^2-[-3(-3x)]$

$=4x^2-9x$

The Mixed Exercise number 13 is on page **262**

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Chapter 3–Common Fractions

Common Fractions (from pages 28 - 34)

Mixed Exercise:

1) Determine the following without using a calculator and showing all calculations:

a) $\frac{5}{3}+\frac{1}{3}$

b) $\frac{2}{5}+\frac{13}{5}$

c) $\frac{1}{2}+\frac{1}{3}$

d) $\frac{5}{4}-\frac{3}{4}$

e) $\frac{1}{8}-\frac{2}{5}$

f) $\frac{x}{2}-\frac{2x}{3}$

g) $\frac{x}{y}+x$

h) $\frac{p}{4}-\frac{6}{p}$

i) $\frac{3}{r}-\frac{r}{2}$

Solutions to the Mixed Exercise number 1 are on page **268**

2) Determine the following without using a calculator and showing all calculations:

a) $\frac{x}{5}+\frac{2x}{3}-\frac{5}{3}$

b) $\frac{x}{2}-\frac{3}{2}-\frac{2x}{4}+\frac{3}{4}+1$

c) $\frac{y}{2y}-\frac{3}{y}-\frac{2y}{3}+\frac{1}{3}-2y$

d) $\frac{2}{3x}-\frac{p}{2}+\frac{5}{2}-2p$

e) $\frac{a}{b}+\frac{a}{3}-\frac{3}{b}+\frac{5}{2}-b$

f) $\frac{a}{b}+\frac{5}{3}-\frac{3}{b}+\frac{a}{3}-b$

Solutions to the Mixed Exercise number 2 are on page **268**

3) Determine the following without using a calculator and showing all calculations:

a) $\frac{2}{5}\times\left(\frac{1}{5}+1\right)$

b) $\frac{1}{2}\div\left(2\frac{1}{2}-\frac{2}{3}\right)$

c) $\frac{1}{2}\div 2\frac{1}{2}-\frac{2}{3}$

d) $\frac{1}{3}\div\frac{1}{3}\div\frac{1}{2}$

e) $\frac{1}{3}\div\left(\frac{1}{3}\div\frac{1}{2}\right)$

f) $\frac{1}{3}\div\left(\frac{2}{3}\times\frac{1}{2}\right)$

g) $\frac{1}{3}\div\frac{2}{3}\times\frac{1}{2}$

h) $\frac{2}{3}-\frac{2}{3}\div\frac{2}{3}$

i) $\left(\frac{2}{3}-\frac{2}{3}\right)\div\frac{2}{3}$

Solutions to the Mixed Exercise number 3*a* to *f* are on page **268** and *g* to *i* are on page **269**

4) Determine the following without using a calculator and showing all calculations:

a) $\dfrac{\frac{1}{2}+\frac{1}{3}}{\frac{3}{4}+\frac{1}{3}}$

b) $\dfrac{x+\frac{1}{2x}}{\frac{1}{2}+\frac{3}{x}}$

c) $\dfrac{\frac{2}{3x}-\frac{3}{4x}}{\frac{1}{2x}+\frac{1}{3x}}$

Solutions to the Mixed Exercise number 4 are on page **269**

5) Simplify.

a) $\frac{3x}{2y}\times\frac{5y}{12x}$

b) $\frac{3x}{5y}\times\frac{2y}{8}\times\frac{15}{4x}$

c) $\frac{5x}{6a^2}\div\frac{20b}{3a}\times\frac{3}{5}$

d) $\frac{10x}{9y}+\frac{6}{15y}\div\frac{6}{5y}$

e) $\frac{5x}{9}\times\frac{5}{3x}\div\frac{5}{3}$

f) $\frac{2}{3}$ of $\left(\frac{3x}{2}\div 4x\right)$

Solutions to the Mixed Exercise number 5 are on page **269**

6) Simplify.

a) $\sqrt[3]{\frac{27x^{12}}{y^3}}$

b) $\sqrt{x^2+\frac{9x^2}{16}}$

c) $\sqrt[3]{\frac{-27}{8}}\times\sqrt{\frac{2^2}{9}}$

d) $\left(x+\frac{3x}{2}\right)^3\div\frac{125x}{8}$

e) $\left(\sqrt{25x^4}\right)^2\div 50x^2$

f) $\sqrt{3\frac{1}{16}\div\frac{-7}{4}}$

Solutions to the Mixed Exercise number 6 are on page **269**

7) Express each of the following percentages as a common fraction:

a) 33%

b) 65%

c) 80%

Solutions to the Mixed Exercise number 7 are on page **270**

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8) A fruit salad is made of 25% apples, 33% Melons, 10% grapes, 27% fruit juice and the remainder of the fruit salad consists of oranges.

a) What percentage of the fruit salad does oranges make up?

b) In a 900g tub of fruit salad, determine the mass of apples, oranges, melons, grapes and oranges.

Solutions to the Mixed Exercise number 8 are on page **270**

9) Sam's mathematics year mark is calculated using a weighted average. The final exam is weighted 75% of his mark and the remainder of his mark is made up of his portfolio.

a) What percentage of Sam's year mark does portfolio make up?

b) A portfolio assignment counts 20% of the portfolio. What fraction of Sam's final year mark does his portfolio assignment count?

Solutions to the Mixed Exercise number 9 are on page **270**

10) Imaan prepared a study timetable. She assigned a total of 50 hours studying. Two fifths of this time were allocated to maths, a quarter was allocated to science, 20 percent to accounting and the remaining time was spilt between her other subjects.

a) How many hours did she allocate to maths?

b) How many hours did she allocate to science?

c) How many hours did she allocate to accounting?

d) What fraction of time did she allocate to her remaining subjects?

e) How many hours were allocated to her remaining subjects?

Solutions to the Mixed Exercise number 10 are on page **270**

11) A bottling plant fills a fruit juice bottle with carbonated water and juice concentrate. The water is filled from a container which can hold enough water to fully fill 360 bottles.
One quarter of each bottle is filled with concentrate and three quarters is filled with water. How many bottles can be filled with the water from the container?

Solutions to the Mixed Exercise number 11 are on page **270**

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Chapter 3–Common Fractions (Solutions)

Mixed Exercise Solutions:

1)

a) $\frac{5}{3}+\frac{1}{3}=\frac{5+1}{3}$

$=\frac{6}{3}$

$=2$

b) $\frac{2}{5}+\frac{13}{5}=\frac{2+13}{5}$

$=\frac{15}{5}$

$=3$

c) $\frac{1}{2}+\frac{1}{3}=\frac{3+2}{6}$

$=\frac{5}{6}$

d) $\frac{5}{4}-\frac{3}{4}=\frac{5-3}{4}$

$=\frac{2}{4}$

$=\frac{1}{2}$

e) $\frac{1}{8}-\frac{2}{5}=\frac{5-16}{40}$

$=-\frac{11}{40}$

f) $\frac{x}{2}-\frac{2x}{3}=\frac{3x-4x}{6}$

$=-\frac{x}{6}$

g) $\frac{x}{y}+x$

$\frac{x+xy}{y}$

h) $\frac{p}{4}-\frac{6}{p}$

$=\frac{p^2-24}{4p}$

i) $\frac{3}{r}-\frac{r}{2}$

$=\frac{6-r^2}{2r}$

The Mixed Exercise number 1 is on page **266**

2)

a) $\frac{x}{5}+\frac{2x}{3}-\frac{5}{3}=\frac{3x+10x-25}{15}$

$=\frac{13x-25}{15}$

b) $\frac{x}{2}-\frac{3}{2}-\frac{2x}{4}+\frac{3}{4}+1=\frac{2x-6-2x+3+4}{4}$

$=\frac{1}{4}$

c) $\frac{y}{2y}-\frac{3}{y}-\frac{2y}{3}+\frac{1}{3}-2y=\frac{3y-18-4y^2+2y-12y^2}{6y}$

$=\frac{-16y^2+5y-18}{6y}$

d) $\frac{2}{3x}-\frac{p}{2}+\frac{5}{2}-2p=\frac{4-3px+15x-12px}{6x}$

$=\frac{-15px+15x+4}{6x}$

e) $\frac{a}{b}+\frac{a}{3}-\frac{3}{b}+\frac{5}{2}-b$

$=\frac{6a+2ab-18+15b-6b^2}{6b}$

f) $\frac{a}{b}+\frac{5}{3}-\frac{3}{b}+\frac{a}{3}-b$

$=\frac{3a+5b-9+ab-3b^2}{3b}$

The Mixed Exercise number 2 is on page **266**

3)

a) $\frac{2}{5}\times\left(\frac{1}{5}+1\right)=\frac{2}{5}\times\left(\frac{1+5}{5}\right)$

$=\frac{2}{5}\times\frac{6}{5}$

$=\frac{12}{25}$

b) $\frac{1}{2}\div\left(2\frac{1}{2}-\frac{2}{3}\right)=\frac{1}{2}\div\left(\frac{5}{2}-\frac{2}{3}\right)$

$=\frac{1}{2}\div\left(\frac{15-4}{6}\right)$

$=\frac{1}{2}\div\left(\frac{11}{6}\right)$

$=\frac{1}{\cancel{2}}\times\frac{\cancel{6}^{3}}{11}$

$=\frac{3}{11}$

c) $\left(\frac{1}{2}\div2\frac{1}{2}\right)-\frac{2}{3}=\left(\frac{1}{2}\div\frac{5}{2}\right)-\frac{2}{3}$

$=\left(\frac{1}{2}\times\frac{2}{5}\right)-\frac{2}{3}$

$=\frac{1}{5}-\frac{2}{3}$

$=-\frac{7}{15}$

d) $\left(\frac{1}{3}\div\frac{1}{3}\right)\div\frac{1}{2}=\left(\frac{1}{3}\times\frac{3}{1}\right)\div\frac{1}{2}$

$=\left(\frac{1}{\cancel{3}}\times\frac{\cancel{3}}{1}\right)\div\frac{1}{2}$

$=1\times\frac{2}{1}$

$=2$

e) $\frac{1}{3}\div\left(\frac{1}{3}\div\frac{1}{2}\right)$

$=\frac{1}{3}\div\left(\frac{1}{3}\times\frac{2}{1}\right)$

$=\frac{1}{\cancel{3}}\times\frac{\cancel{3}}{2}$

$=\frac{1}{2}$

f) $\frac{1}{3}\div\left(\frac{2}{3}\times\frac{1}{2}\right)$

$=\frac{1}{3}\div\left(\frac{\cancel{2}}{3}\times\frac{1}{\cancel{2}}\right)$

$=\frac{1}{\cancel{3}}\times\frac{\cancel{3}}{1}$

$=1$

The Mixed Exercise number 3 is on page **266**, answers are continued on the next page

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g) $\left(\frac{1}{3} \div \frac{2}{3}\right) \times \frac{1}{2} = \frac{1}{3} \times \frac{3}{2} \times \frac{2}{3}$

$= \frac{1}{3} \times \frac{\cancel{3}}{\cancel{2}} \times \frac{\cancel{2}}{\cancel{3}}$

$= \frac{1}{3}$

h) $\frac{2}{3} - \left(\frac{2}{3} \div \frac{2}{3}\right) = \frac{2}{3} - \frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{2}}$

$= \frac{2}{3} - 1$

$= \frac{2-3}{3}$

$= -\frac{1}{3}$

i) $\left(\frac{2}{3} - \frac{2}{3}\right) \div \frac{2}{3}$

$= 0 \div \frac{2}{3}$

$= 0$

The Mixed Exercise number 3 is on page **266**

4)

a) $\left(\frac{1}{2} + \frac{1}{3}\right) \div \left(\frac{3}{4} + \frac{1}{3}\right)$

$= \frac{5}{6} \div \frac{13}{12}$

$= \frac{5}{\cancel{6}} \times \frac{\cancel{12}^{2}}{13}$

$= \frac{10}{13}$

b) $\left(x + \frac{1}{2x}\right) \div \left(\frac{1}{2} + \frac{3}{x}\right)$

$= \left(\frac{2x^2+1}{2x}\right) \div \left(\frac{x+6}{2x}\right)$

$= \frac{2x^2+1}{2x} \times \frac{2x}{x+6}$

$= \frac{2x^2+1}{x+6}$

c) $\left(\frac{2}{3x} - \frac{3}{4x}\right) \div \left(\frac{1}{2x} + \frac{1}{3x}\right)$

$= \left(\frac{8-9}{12x}\right) \div \left(\frac{3+2}{6x}\right)$

$= \frac{-1}{\cancel{12}^{2} \cancel{x}} \times \frac{\cancel{6} \cancel{x}}{5}$

$= -\frac{1}{10}$

The Mixed Exercise number 4 is on page **266**

5)

a) $\frac{\cancel{3} \cancel{x}}{2 \cancel{y}} \times \frac{5 \cancel{y}}{\cancel{12}^{4} \cancel{x}}$

$= \frac{5}{8}$

b) $\frac{3 \cancel{x}}{\cancel{5} \cancel{y}} \times \frac{\cancel{2} \cancel{y}}{\cancel{8}^{4}} \times \frac{\cancel{15}^{3}}{4 \cancel{x}}$

$= \frac{9}{16}$

c) $\frac{5x}{6a^2} \div \frac{20b}{3a} \times \frac{3}{5}$

$= \frac{\cancel{5} x}{\cancel{6}^{2} a^{\cancel{2}}} \times \frac{\cancel{3} \cancel{a}}{20b} \times \frac{3}{\cancel{5}}$

$= \frac{3x}{40ab}$

d) $\frac{10x}{9y} + \frac{6}{15y} \div \frac{6}{5y}$

$= \frac{10x}{9y} + \frac{\cancel{6}}{\cancel{15}^{3} \cancel{y}} \times \frac{\cancel{5} \cancel{y}}{\cancel{6}}$

$= \frac{10x}{9y} + \frac{1}{3}$

$= \frac{10x+3y}{9y}$

e) $\frac{5x}{9} \times \left(\frac{5}{3x} \div \frac{5}{3}\right)$

$= \frac{5 \cancel{x}}{9} \times \frac{\cancel{5}}{\cancel{3} \cancel{x}} \times \frac{\cancel{3}}{\cancel{5}}$

$= \frac{5}{9}$

f) $\frac{2}{3}$ of $\left(\frac{3x}{2} \div 4x\right)$

$= \frac{2}{3}$ of $\left(\frac{3 \cancel{x}}{2} \times \frac{1}{4 \cancel{x}}\right)$

$= \frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{8}^{4}}$

$= \frac{1}{4}$

The Mixed Exercise number 5 is on page **266**

6)

a) $\sqrt[3]{\frac{27x^{12}}{y^3}} = \frac{3x^4}{y}$

b) $\sqrt{x^2 + \frac{9x^2}{16}}$

$= \sqrt{\frac{16x^2 + 9x^2}{16}}$

$= \sqrt{\frac{25x^2}{16}}$

$= \frac{5x}{4}$

c) $\sqrt[3]{\frac{-27}{8}} \times \sqrt{\frac{2^2}{9}}$

$= -\frac{3}{\cancel{2}} \times \frac{\cancel{2}}{3}$

$= -1$

d) $\left(x + \frac{3x}{2}\right)^3 \div \frac{125x}{8}$

$= \left(\frac{2x+3x}{2}\right)^3 \div \frac{125x}{8}$

$= \frac{\cancel{125} x^{\cancel{3}2}}{\cancel{8}} \times \frac{\cancel{8}}{\cancel{125} \cancel{x}} = x^2$

e) $\left(\sqrt{25x^4}\right)^2 \div 50x^2$

$= 25x^4 \div 50x^2$

$= \frac{\cancel{25} x^{\cancel{4}2}}{1} \times \frac{1}{\cancel{50}^{2} \cancel{x^2}} = \frac{x^2}{2}$

f) $\sqrt{3\frac{1}{16}} \div \frac{-7}{4} = \sqrt{\frac{49}{16}} \times \frac{4}{-7}$

$= \frac{\cancel{7}}{\cancel{4}} \times \frac{\cancel{4}}{\cancel{-7}}$

$= -1$

The Mixed Exercise number 6 is on page **266**

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7)

a) $33\% = \frac{33}{100}$

b) $65\% = \frac{65}{100}$
$= \frac{13}{20}$

c) $80\% = \frac{80}{100}$
$= \frac{4}{5}$

The Mixed Exercise number 7 is on page **266**

8)

a) $100\% - 25\% - 33\% - 10\% - 27\%$
$= 5\%$

b) Apples: $\frac{25}{100} \times 900$
$= 225g$

Melons: $\frac{33}{100} \times 900$
$= 297g$

Grapes: $\frac{10}{100} \times 900$
$= 90g$

Oranges: $\frac{5}{100} \times 900$
$= 25g$

The Mixed Exercise number 8 is on page **267**

9)

a) 25%

b) $\frac{20}{100} \times \frac{25}{100}$
$= \frac{500}{10\,000}$
$= \frac{1}{20}$

The Mixed Exercise number 9 is on page **267**

10)

a) $\frac{2}{5} \times 50$
$= 20$ hours

b) $\frac{1}{4} \times 50$
$= 12{,}5$ hours

c) $\frac{20}{100} \times 50$
$= 10$ hours

d) $1 - \frac{2}{5} - \frac{1}{4} - \frac{20}{100}$
$= \frac{3}{20}$

e) $50 \times \frac{3}{20}$
$= 7{,}5$ hours

The Mixed Exercise number 10 is on page **267**

11) To determine the number of bottles that can be filled you must first determine the number of bottles saved by only filling three quarters of each bottle:

$360 \times \frac{1}{4} \rightarrow \frac{1}{4}$ is saved each time a bottle is filled
$= 90$ bottles

$\therefore$ Total number of bottles that can be filled $= 360 + 90$
$= 450$ bottles

The Mixed Exercise number 11 is on page **267**

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Chapter 4 – Decimal Fractions

Decimal Fractions Revision (from page 36)

Exercise 1:

1) Write the following as a decimal:

a) $\frac{22}{100}$ c) $\frac{9}{20}$ e) $\frac{7}{50}$

b) $\frac{9}{5}$ d) $\frac{4}{125}$ f) $\frac{3}{250}$

Solutions to Exercise 1 number 1 are on page 273

2) Express the following decimals as a fraction in their simplest form:

a) 0,31 c) 0,66 e) 0,013

b) 0,05 d) 0,57 f) 0,001

Solutions to Exercise 1 number 2 are on page 273

Addition and Subtraction of Decimal Fractions (from page 37)

Exercise 2:

1) Calculate the value of the following:

a) $0{,}3x + 0{,}27x$ c) $0{,}357a + 0{,}45a$ e) $0{,}35c + 0{,}25c - 0{,}208c$

b) $0{,}25y - 0{,}35y$ d) $2{,}12b - 1{,}1b$ f) $1{,}35r + 0{,}1r + 2{,}0r$

Solutions to Exercise 2 number 1 are on page 273

2) The table below shows the times (in minutes) it took two Grade 9 learners to complete three consecutive mathematics tasks.

	Task 1	Task 2	Task 3
Learner A	5,02	4,08	6,11
Learner B	5,33	3,55	6,02

a) Who completed all 3 tasks first?

b) How much faster or slower was learner B?

Solutions to Exercise 2 number 2 are on page 273

3) A Grade 9 learner packs his bag which has a mass of 650g, with 5 textbooks. The weights of the textbooks are 1,25kg, 900g, 1,11kg, 850g and 1,1kg. what is the total mass of his bag? (hint: there are 1000 grams in a kilogram)

Solutions to Exercise 2 number 3 are on page 274

Multiplication and Division of Decimal Fractions (from pages 37 - 39)

Exercise 3:

1) Calculate the value of the following:

a) $2{,}1x \times 0{,}2y$ c) $3{,}6x \div 0{,}2y$ e) $3{,}6a \div 0{,}02$

b) $0{,}3x \times 0{,}001$ d) $36x \div 0{,}2y$ f) $-0{,}3f \div 6f$

Solutions to Exercise 3 number 1 are on page 274

2) A sweet shop charges R5 per 100g of sweets:

a) Determine the cost of 250g of sweets.

b) If a bill came to R62,50, how many grams of sweets were purchased?

Solutions to Exercise 3 number 2 are on page 274

3) A 1,2m high box contains reams of paper, each of which is 0,2m high. How many reams of paper does the box hold?

Solutions to Exercise 3 number 3 are on page 274

Squares, Cubes Square Roots and Cube Roots (from page 39)

Exercise 4:

1) Determine the value of:

a) $(1{,}1x)^2$ c) $(0{,}2x)^3$ e) $(0{,}06b)^2$

b) $(-0{,}04a)^2$ d) $(-0{,}4p)^3$ f) $(-0{,}03c)^3$

Solutions to Exercise 4 number 1 are on page 275

2)

a) $\sqrt{0{,}09x^4}$ c) $\sqrt{-0{,}1a^2}$ e) $\sqrt[3]{-0{,}001h^3}$

b) $\sqrt{1{,}44y^8}$ d) $\sqrt[3]{0{,}027a^6}$ f) $\sqrt[3]{-0{,}008x^9}$

Solutions to Exercise 4 number 2 are on page 275

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3) Determine the value of:

a) $\left(0{,}1x^2 + 0{,}15x^2\right)^2$ **b)** $\left(\sqrt{0{,}16p^2} - 0{,}2p\right)^2$ **c)** $\sqrt{0{,}9x^2 - 0{,}65x^2}$

Solutions to Exercise 4 number 3 are on page **275**

The Mixed Exercise

1) The rectangle below has a breadth of 0,18x units in length. Its length is twice its breadth. What is the area of the rectangle? Give your answer in terms of x. (area of a rectangle is length × breadth)

Solutions to the Mixed Exercise number 1 are on page **275**

2) Nandi purchases ten 1,25 litre bottles of cold drink for a party. She has also purchased polystyrene cups which can each hold 0,25 litres of liquid.

a) How many cups can be filled using the 10 bottles she purchased.

b) After the party Nandi has some leftover cold drink. If she could fill 15 cups with the leftover cold drink, how many bottles did she have leftover?

Solutions to the Mixed Exercise number 2 are on page **276**

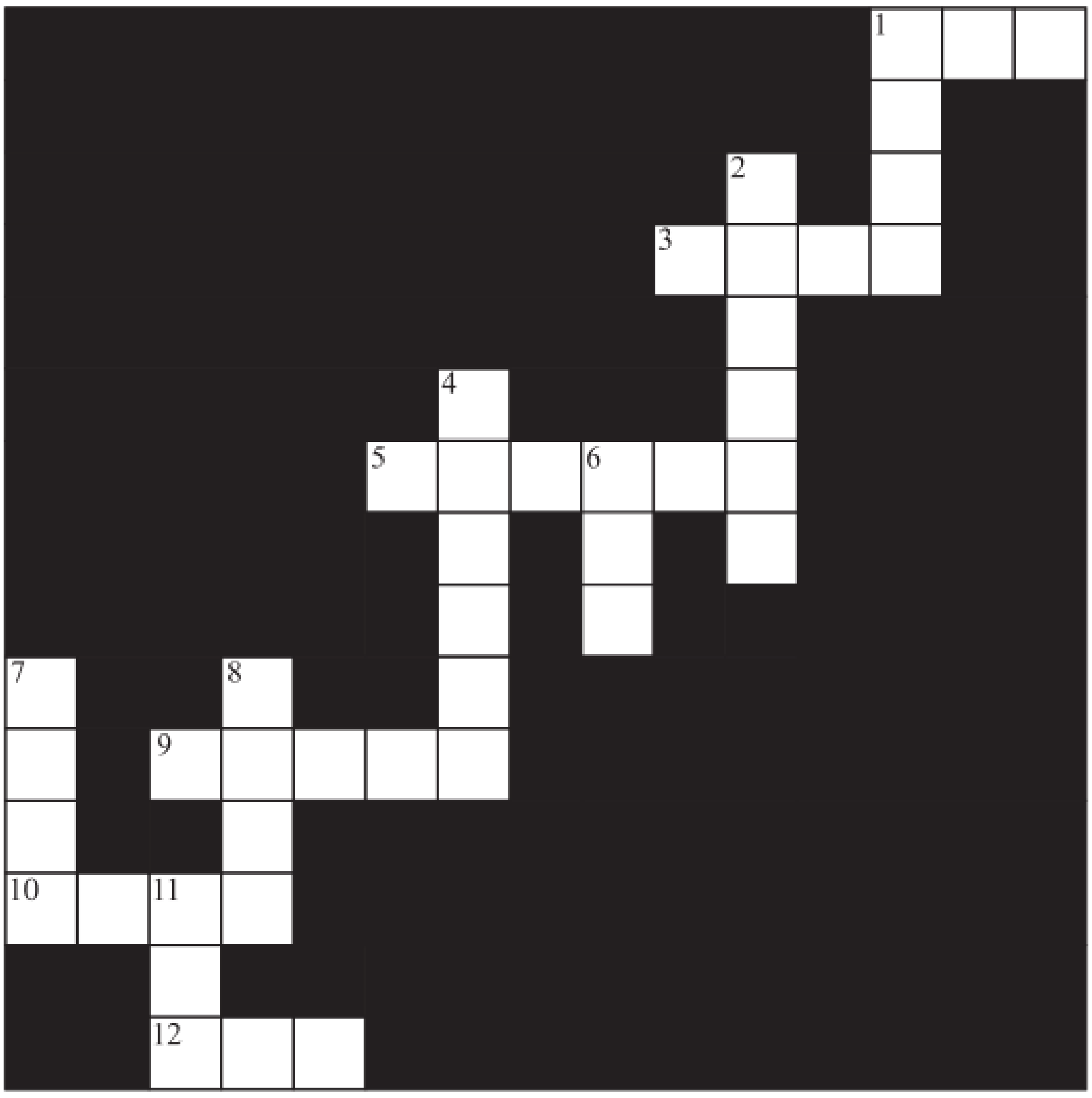
3) Aiden and Rajesh are Grade 9 learners who did not do their maths homework. As punishment they must stay after school to help paint decorations for the Matric dance. Each decoration requires 150ml of paint.

a) They are given 7,5 litres of paint. How many decorations can they paint?(Hint: there are 1000ml in 1 litre)

b) If they paint 20 decorations how much paint will be leftover?

Solutions to the Mixed Exercise number 3 are on page **276**

4) Complete the crossword below. Note that decimal commas count as a block.



Across:		Down:	
1.	0,25 + 0,35	**1.**	$\frac{3}{5} \times \frac{5}{2} \div \frac{24}{12}$
3.	25 ÷ 100	**2.**	$0{,}4x \times 0{,}3y$
5.	$1{,}234x + 0{,}15x - 0{,}75x$	**4.**	$0{,}25x - 0{,}125x$
9.	$0{,}07x + 1{,}15x$	**6.**	$0{,}45xy \div 0{,}15$
10.	$\sqrt{1{,}21x^2}$	**7.**	−2,2 + 1,1
12.	0,3 + 0,6	**8.**	$\sqrt{0{,}16x^2}$
		11.	1,5 ÷ 0,015

Solutions to the Mixed Exercise number 4 are on page **276**

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Chapter 4 – Decimal Fractions (Solutions)

Exercise 1 Solutions:

1)

a) 0,22

b) $\frac{9}{5}$
$= \frac{18}{10}$
$= 1,8$

c) $\frac{9}{20}$
$= \frac{45}{100}$
$= 0,45$

d) $\frac{4}{125}$
$= \frac{32}{1000}$
$= 0,032$

e) $\frac{7}{50}$
$= \frac{14}{100}$
$= 0,14$

f) $\frac{3}{250}$
$= \frac{12}{1000}$
$= 0,012$

Exercise 1 number 1 is on page **271**

2)

a) $\frac{31}{100}$

b) $\frac{5}{100}$
$= \frac{1}{20}$

c) $\frac{66}{100}$
$= \frac{33}{50}$

d) $\frac{57}{100}$

e) $\frac{13}{1000}$

f) $\frac{1}{1000}$

Exercise 1 number 2 is on page **271**

Exercise 2 Solutions:

1)

a) $\frac{30x}{100} + \frac{27x}{100}$
$= \frac{57x}{100}$
$= 0,57x$

b) $\frac{25y}{100} - \frac{35y}{100}$
$= -\frac{10y}{100}$
$= -0,1y$

c) $\frac{357a}{1000} + \frac{450a}{1000}$
$= \frac{807a}{1000}$
$= 0,807a$

d) $\frac{212b}{100} - \frac{110b}{100}$
$= \frac{102b}{100}$
$= 1,02b$

e) $\frac{350c}{1000} + \frac{250c}{1000} - \frac{208c}{1000}$
$= \frac{392c}{1000}$
$= 0,392c$

f) $\frac{135r}{100} + \frac{10r}{100} + \frac{200r}{100}$
$= \frac{345r}{100}$
$= 3,45r$

Exercise 2 number 1 is on page **271**

2)

a) Learner A:

$\text{Total time} = \frac{502}{100} + \frac{408}{100} + \frac{611}{100}$
$= \frac{1521}{100}$
$= 15,21$

Learner B:

$\text{Total time} = \frac{533}{100} + \frac{355}{100} + \frac{602}{100}$
$= \frac{1490}{100}$
$= 14,90$

$\therefore$ Learner B finished first

b) $\frac{1521}{100} - \frac{1490}{100}$
$= \frac{31}{100} = 0,31$

$\therefore$ Learner B was 0,31 seconds faster than learner A

Exercise 2 number 2 is on page **271**

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3) Mass of bag $= 0,65 + 1,25 + 0,9 + 1,11 + 0,85 + 1,1$

$$= \frac{65 + 125 + 90 + 111 + 85 + 110}{100}$$

$$= \frac{586}{100}$$

$$= 5,86\,\text{kg}$$

Exercise 2 number 3 is on page **271**

Exercise 3 Solutions:

1)

a) $\frac{21x}{10} \times \frac{2y}{10}$

$= \frac{42xy}{100}$

$= 0,42xy$

b) $\frac{3x}{10} \times \frac{1}{1000}$

$= \frac{3x}{10\,000}$

$= 0,0003x$

c) $\frac{36x}{10} \div \frac{2y}{10}$

$= \frac{36x}{10} \times \frac{10}{2y}$

$= \frac{18x}{y}$

d) $\frac{36x}{1} \div \frac{2y}{10}$

$= \frac{\cancel{36}^{18}x}{1} \times \frac{10}{\cancel{2}^{1}y}$

$= \frac{180x}{y}$

e) $\frac{36a}{10} \div \frac{2}{100}$

$= \frac{\cancel{36}^{18}a}{\cancel{10}^{1}} \times \frac{\cancel{100}^{10}}{\cancel{2}^{1}}$

$= 180a$

f) $-\frac{3f}{10} \div \frac{6f}{1}$

$= -\frac{\cancel{3}^{1}\cancel{f}}{10} \times \frac{1}{\cancel{6}^{2}\cancel{f}}$

$= -\frac{1}{20}$

$= -\frac{5}{100}$

$= -0,05$

Exercise 3 number 1 is on page **271**

2)

a) $\frac{5}{1} \times \frac{25}{10}$

$= \frac{125}{10}$

$= \text{R}12,50$

b) $\left(\frac{625}{10} \div \frac{5}{1}\right) \times 100$

$= \left(\frac{\cancel{625}^{125}}{10} \times \frac{1}{\cancel{5}}\right) \times 100$

$= \frac{125}{10} \times \frac{100}{1}$

$= 1250$g were purchased

Exercise 3 number 2 is on page **271**

3) $1,2 \div 0,2 = \frac{12}{10} \div \frac{2}{10}$

$= \frac{\cancel{12}^{6}}{\cancel{10}} \times \frac{\cancel{10}}{\cancel{2}^{1}}$

$= 6$ reams of paper

Exercise 3 number 3 is on page **271**

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Exercise 4 Solutions:

1)

a) $\left(\frac{11x}{10}\right)^2$
$=\frac{121x^2}{100}$
$=1,21x^2$

b) $\left(-\frac{4a}{100}\right)^2$
$=\frac{16a}{10\,000}$
$=0,0016a$

c) $\left(\frac{2x}{10}\right)^3$
$=\frac{8x^3}{1000}$
$=0,008x^3$

d) $\left(-\frac{4p}{10}\right)^3$
$=-\frac{64p^3}{1000}$
$=-0,064p^3$

e) $\left(\frac{6b}{100}\right)^2$
$=\frac{36b^2}{10\,000}$
$=0,0036b^2$

f) $\left(-\frac{3c}{100}\right)^3$
$=-\frac{27c^3}{100\,000}$
$=-0,000027c^3$

Exercise 4 number 1 is on page **271**

2)

a) $\sqrt{\frac{9x^4}{100}}$
$=\frac{3x^2}{10}$
$=0,3x^2$

b) $\sqrt{\frac{144y^8}{100}}$
$=\frac{12y^4}{10}$
$=1,2y^4$

c) $\sqrt{-0,1a^2}$
$=$ No solution

d) $\sqrt[3]{\frac{27a^6}{1000}}$
$=\frac{3a^2}{10}$
$=0,3a^2$

e) $\sqrt[3]{-\frac{h^3}{1000}}$
$=-\frac{h}{10}$
$=-0,1h$

f) $\sqrt[3]{-\frac{8x^9}{1000}}$
$=-\frac{2x^3}{10}$
$=-0,2x^3$

Exercise 4 number 2 is on page **271**

3)

a) $\left(\frac{10x^2}{100}+\frac{15x^2}{100}\right)^2$
$=\left(\frac{25x^2}{100}\right)^2$
$=\frac{25^2x^4}{100^2}$
$=\frac{625x^4}{10\,000}$
$=0,0625x^4$

b) $\left(\sqrt{\frac{16p^2}{100}}-\frac{2p}{10}\right)^2$
$=\left(\frac{4p}{10}-\frac{2p}{10}\right)^2$
$=\frac{2^2p^2}{10^2}$
$=\frac{4p^2}{100}$
$=0,04p^2$

c) $\sqrt{\frac{90x^2}{100}-\frac{65x^2}{100}}$
$==\sqrt{\frac{25x^2}{100}}$
$=\frac{5x}{10}$
$=0,5x$

Exercise 4 number 3 is on page **272**

The Mixed Exercise Solutions:

1) length $=\frac{2}{1}\times\frac{18x}{100}$
$=\frac{36x}{100}$
$=0,36x$ units

Area $=$ length $\times$ breadth
$=\frac{36x}{100}\times\frac{18x}{100}$
$=\frac{648x^2}{10\,000}$
$=0,0648x^2$ units^2

The Mixed Exercise number 1 is on page 272

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2)

a) $\dfrac{125}{100} \div \dfrac{25}{100}$

$= \dfrac{\cancel{125}^{5}}{\cancel{100}} \times \dfrac{\cancel{100}}{\cancel{25}^{1}}$

$= 5$ cups per bottle

$\therefore$ with 10 bottles she can fill 50 cups.

b) $15 \times \dfrac{25}{100}$

$= \dfrac{15}{1} \times \dfrac{1}{4}$

$= \dfrac{15}{4} \rightarrow$ the amount of cold drink left over

now calculate how many bottles this makes up:

$\dfrac{15}{4} \div \dfrac{125}{100}$

$= \dfrac{15}{4} \times \dfrac{100}{125}$

$= \dfrac{1500}{500}$

$= 3$ bottles

The Mixed Exercise number 2 is on page **272**

3)

a) $\dfrac{15}{1000} \div \dfrac{75}{10} \rightarrow 150ml = 0{,}15$ litres

$= \dfrac{\cancel{75}^{5}}{\cancel{10}^{1}} \times \dfrac{\cancel{100}^{10}}{\cancel{15}^{1}}$

$= 50$ decorations

b) $\dfrac{20}{1} \times \dfrac{15}{100}$

$= \dfrac{300}{100}$

$= 3$ litres of paint was used

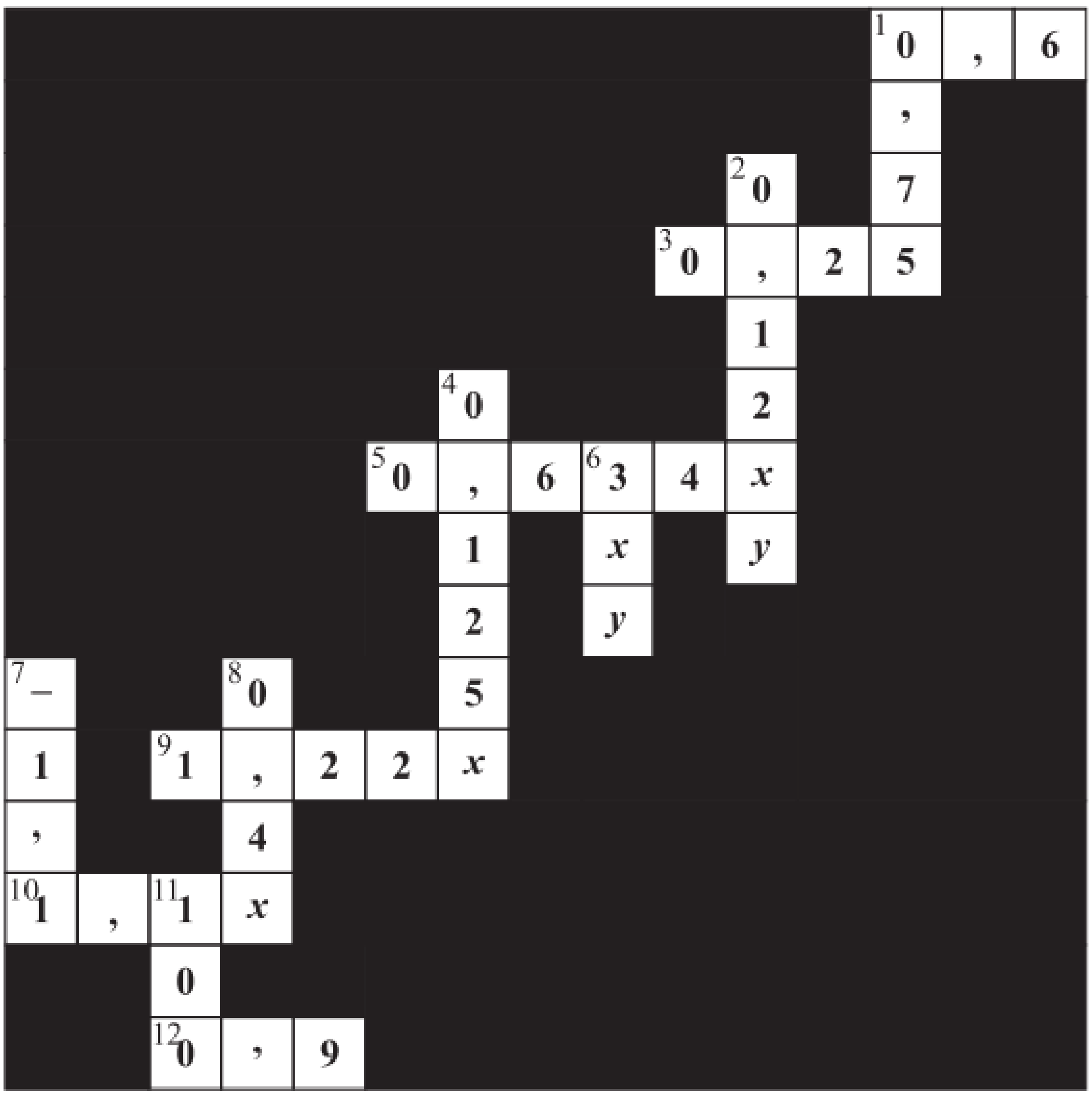
Leftover paint $= \dfrac{75}{10} - \dfrac{30}{10}$

$= \dfrac{45}{10}$

$= 4{,}5$ litres leftover

The Mixed Exercise number 3 is on page **272**

4)



The Mixed Exercise number 4 is on page **272**

Chapter 5 – Exponents

Grade 8 Revision (from pages 42 - 44)

Exercise 1:

Simplify the following expressions (you may assume all denominators are not equal to 0):

a) $p^3 \times p^2 \times p$

b) $5x^2 \times -3x^4$

c) $7a^4 \times 2a^2 \times 2b^2$

d) $3p^2q \times 2pq^2$

e) $\dfrac{x^9}{x^5}$

f) $\dfrac{a^3b^8}{a^2b^5}$

g) $3x^3y^2 \times -2x^4y^4 \times 2x^5$

h) $-3a^2b.2a^3b$

i) $\dfrac{(2p^2q)^2}{(pq)^2}$

j) $(-3ab)^2(2a^2b)^3$

k) $\dfrac{(2pqr)^3}{4pqr}$

l) $8x^0 \times (8x)^0$

m) $3^2 \times ab + (2^4a^2b^2)^{\frac{1}{2}}$

n) $3(x+y)^0 \times 2 + 256^0 + 8k^0$

o) $-(-2x^3y^2)^2$

p) $\left[x^3(3xy)^2\right]^2$

q) $3r^2p \times 5r^9p^2$

r) $3xy \times 2x^2y^4.5x^2y^2$

s) $\left(\dfrac{4pt}{5sr}\right)^2$

Solutions to Exercise 1 are on page **280**

Negative Exponents (from pages 45-47)

Exercise 2:

1) **Simplify the following and write all answers with positive exponents:**

a) a^{-12}

b) $\dfrac{1}{x^{-9}}$

c) $5x^{-3}$

d) $\dfrac{5}{x^{-3}}$

e) $\dfrac{x^{-3}}{5}$

f) $\dfrac{p^4}{q^{-3}}$

g) $x^3.y^{-4}$

h) $\dfrac{4}{2^{-1}}$

i) 4.2^{-1}

j) $5^{-3}x$

k) $\dfrac{1}{(5p)^{-2}}$

l) $\dfrac{1}{5p^{-2}}$

m) $\dfrac{x^{-3}}{y^{-2}}$

n) $\dfrac{(2xy)^{-2}}{x^{-3}}$

o) $(-2x^{-2}y^{-3})^3$

Solutions to Exercise 2 number 1*a* to *c* are on page **280** and *d* to *o* are on page **281**

2) **Simplify the following and write all answers with positive exponents:**

a) $(3x^2y^4)^3 \times 2xy^{-2}$

b) $(-5x^{-2}y^3)^2 \div 10xy^{-2}$

c) $(-6p^2r^3)(-2p^{-1}r^3)^2$

d) $\dfrac{x^3y^{-3}z^7}{x^{-1}y^2z^{-4}}$

e) $\dfrac{(7a^{-3}b^4)^2}{m^{-8}n^9}$

f) $\left(\dfrac{5p^3q^{-2}}{r^{-5}}\right)^2$

g) $\dfrac{(3x)^{-1}}{(5y)^{-2}}$

h) $\dfrac{1}{2x^{-1}} + 2^{-1}.x - (-2)^0x$

i) $\dfrac{a+b}{a^{-1}+b^{-1}}$

j) $\left(\dfrac{x^3+2x^3}{x \times x}\right)^2$

Solutions to Exercise 2 number 2 are on page **281**

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Exponential Equations (from page 48 and 49)

Exercise 3:

1) Solve for *x* in the following equations:

a) $3^x = 3$
b) $3^x = 9$
c) $3^{3x} = 27$
d) $5^x = 125$
e) $7^x = 1$
f) $7^{x+1} = 49$
g) $4^{3x} = 64$
h) $11^{x-5} = 1$
i) $3.13^x = 39$
j) $3^x.3^2 = 27$
k) $8^x.4 = 256$
l) $18 \times 37^x = 18$
m) $8^x = 16$
n) $27^x = \frac{1}{27}$

Solutions to Exercise 3 number 1 are on page **282**

2) Solve for the unknown variable in the following equations:

a) $3^{n-5} = \frac{1}{9}$
b) $11^k = \frac{1}{121}$
c) $5^{p-3} = \frac{1}{25}$
d) $\frac{1}{7^a} = 49$
e) $4^{2r-3} = \frac{1}{2^2}$
f) $25^{y-4} = \frac{1}{5^2}$

Solutions to Exercise 3 number 2 are on page **282**

3) Solve for *x* in the following equations:

a) $\frac{1}{49^x} = 343$
b) $\left(\frac{1}{7}\right)^x = \left(\frac{1}{49}\right)$
c) $0,4^x = 0,064$
d) $2^{x+1} = 4^{x-3}$
e) $2^x.2^{x+1} = 8$
f) $3^{3x} \times 4 = 3^{2x} \times 36$

Solutions to Exercise 3 number 3 are on page **282**

4) Solve the following equations:

a) $7^{x+5} = 343$
b) $3^{2x-3} = \frac{1}{27}$
c) $5(3)^{2x-2} = 45$
d) $16\left(2^{x-3}\right) = 8$
e) $121^{x+2} = \frac{1}{11^{3x+1}}$
f) $25\left(\frac{1}{5}\right)^{x+2} = 125$
g) $(2 \times 3)^{\frac{x}{2}} = \frac{1}{36}$

Solutions to Exercise 3 number 4 are on page **283**

Scientific Notation (from page 50-54)

Exercise 4:

1) Write the following numbers in expanded form:

a) $2,3 \times 10^3$
b) $2,3 \times 10^{-3}$
c) $-3,54 \times 10^5$
d) $-3,54 \times 10^{-5}$
e) $5,34085 \times 10^4$
f) $5,34085 \times 10^{-4}$
g) $-2,035 \times 10^3$
h) $-2,035 \times 10^{-3}$
i) $1,3005 \times 10^2$
j) $1,3005 \times 10^{-2}$
k) 5×10^5
l) 5×10^{-5}

Solutions to Exercise 4 number 1 are on page **283**

2) Write the following in scientific notation:

a) 1 203 000
b) 0,0000354
c) 0,0001325
d) 0,0000005
e) 1 200 300 000
f) 0,00000565
g) 0,00000035
h) 55 002
i) 0,00005053
j) 852 000 000 000 000
k) 602 301 000 000
l) 0,0000000005089

Solutions to Exercise 4 number 2 are on page **283**

Exercise 5:

1) Calculate the value of the following writing all answers in scientific notation:

a) $\left(4 \times 10^8\right) \times \left(5 \times 10^{-3}\right)$
b) $\frac{36 \times 10^8}{18 \times 10^3}$
c) $\left(1,5 \times 10^3\right) \times \left(4 \times 10^5\right)$
d) $\frac{24 \times 10^{12}}{3 \times 10^{-4}}$
e) $\left(5 \times 10^{-5}\right) \times \left(7 \times 10^{-4}\right)$
f) $\frac{-12 \times 10^{-4}}{3 \times 10^{-7}}$
g) $\left(3,5 \times 10^{-3}\right) \times \left(5 \times 10^{11}\right)$
h) $\frac{-24 \times 10^{-4}}{-8 \times 10^7}$

Solutions to Exercise 5 number 1 are on page **283**

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2) Calculate the value of the following writing all answers in scientific notation:

a) $5,3\times10^{5}+3\times10^{5}$

b) $2,8\times10^{15}-2\times10^{14}$

c) $5\times10^{5}+3\times10^{8}$

d) $-3,5\times10^{-10}+4\times10^{-11}$

e) $-5,2\times10^{-12}+\left(-4,5\times10^{-13}\right)$

Solutions to Exercise 5 number 2 are on page **284**

Mixed Exercise:

1) Simplify the following expressions leaving all answers with positive exponents:

a) $-2a^{4}b^{6}\times-5ab^{2}$

b) $\dfrac{-6x^{2}y^{3}}{9x^{4}y^{2}}$

c) $5a^{-2}\times3b$

d) $4x^{-3}.x^{4}y^{2}\times-5x^{-4}$

e) $(5x)^{-2}\times5x^{-2}$

f) $5a^{0}b^{8}c\times-3b^{-5}c$

g) $\dfrac{3x^{-3}}{6y}$

h) $(-1)^{50}-(-1)^{51}$

i) $\dfrac{2pq^{2}}{-8p^{-2}q}$

j) $\left(\dfrac{-3a^{-1}}{a^{-4}b^{3}}\right)^{3}$

k) $\dfrac{2^{-1}x^{-2}}{3x^{3}y^{-1}}$

l) $\left(\dfrac{-2x^{-1}y}{-3x^{-2}y^{-2}}\right)^{2}$

m) $3^{-1}+5^{-1}$

n) $\dfrac{5a^{0}}{b}+b^{-1}+\dfrac{b^{-2}}{b^{-1}}$

o) $\left[\left(3x^{2}y^{-2}\right)^{0}\left(3x^{2}y^{-2}\right)^{-2}\right]^{-2}$

p) $\dfrac{x+1}{x^{-1}+1}$

q) $\left(2x^{0}\right)\left(4x^{3}\right)^{0}$

r) $\dfrac{(-1x)^{101}}{(-1x)^{-100}}$

Solutions to the Mixed Exercise number 1 are on page **284**

2) Solve for *x* if:

a) $2^{x-2}=2$

b) $2^{x}=\dfrac{1}{32}$

c) $2\times3^{x+1}-54=0$

d) $\left(\dfrac{1}{121}\right)^{x}=1331$

e) $343^{a}=49^{a+1}$

f) $\dfrac{1}{2}\left(\dfrac{1}{2}\right)^{x}=8$

g) $2\left(2^{2}\right)^{x}=0,5$

h) $3\left(2^{2}\right)^{x}=12$

i) $3.7^{r-1}-1=1028$

j) $3^{256x}+4=5$

k) $6^{3x}=\dfrac{1}{36}$

l) $\dfrac{2^{x}}{3^{x}}=\dfrac{4}{9}$

Solutions to the Mixed Exercise number 2 are on page **285**

3) Below are some interesting numbers in science. Write the numbers in scientific notation.

a) The speed of light is approximately 300 000 000 metres per second.

b) The mass of a proton in an atom is approximately 0,0000000000000000000000000016726219 kg.

c) The mass of the earth is approximately 5 972 000 000 000 000 000 000 000 kg.

d) The mass of an electron is approximately 0,00000000000000000000000000091096 g.

Solutions to the Mixed Exercise number 3 are on page **285**

4) Determine the value of $1,1\times10^{-6}\times5\times10^{-2}$ and write your answer in:

a) Scientific notation.

b) Expanded notation.

Solutions to the Mixed Exercise number 4 are on page **285**

5) Determine the value of $5,3\times10^{-4}+1,4\times10^{-3}$ and write your answer in:

a) Scientific notation.

b) Expanded notation.

Solutions to the Mixed Exercise number 5 are on page **285**

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Chapter 5 – Exponents (Solutions)

Exercise 1 Solutions:

a) $p^3 \times p^2 \times p$

$= p^6$

b) $5x^2 \times -3x^4$

$= -15x^6$

c) $7a^4 \times 2a^2 \times 2b^2$

$= 28a^6b^2$

d) $3p^2q \times 2pq^2$

$= 6p^3q^3$

e) $\frac{x^9}{x^5}$

$= x^4$

f) $\frac{a^3b^8}{a^2b^5}$

$= ab^3$

g) $3x^3y^2 \times -2x^4y^4 \times 2x^5$

$= -12x^{12}y^6$

h) $-3a^2b.2a^3b$

$= -6a^5b^2$

i) $\frac{(2p^2q)^2}{(pq)^2}$

$= \frac{4p^4q^2}{p^2q^2}$

$= 4p^2$

j) $(-3ab)^2(2a^2b)^3$

$= (9a^2b^2)(8a^6b^3)$

$= 72a^8b^5$

k) $\frac{(2pqr)^3}{4pqr}$

$= \frac{8p^3q^3r^3}{4pqr}$

$= 2p^2q^2r^2$

l) $8x^0 \times (8x)^0$

$= 8(1) \times 1$

$= 8$

m) $3^2 \times ab + (2^4a^2b^2)^{\frac{1}{2}}$

$= 9ab + 2^2a^1b^1$

$= 9ab + 4ab$

$= 13ab$

n) $3(x+y)^0 \times 2 + 256^0 + 8k^0$

$= 3(1) \times 2 + 1 + 8(1)$

$= 6 + 1 + 8$

$= 15$

o) $-(-2x^3y^2)^2$

$= -(4x^6y^4)$

$= -4x^6y^4$

p) $\left[x^3(3xy)^2\right]^2$

$= \left[x^3(9x^2y^2)\right]^2$

$= (9x^5y^2)^2$

$= 81x^{10}y^4$

q) $3r^2p \times 5r^9p^2$

$= 15r^{11}p^3$

r) $3xy \times 2x^2y^4.5x^2y^2$

$= 30x^5y^7$

s) $\left(\frac{4pt}{5sr}\right)^2$

$= \frac{16p^2t^2}{25s^2r^2}$

Exercise 1 is on page **277**

Exercise 2 Solutions:

1)

a) a^{-12}

$= \frac{1}{a^{12}}$

b) $\frac{1}{x^{-9}}$

$= x^9$

c) $5x^{-3}$

$= \frac{5}{x^3}$

Exercise 2 number 1 is on page **277**

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d) $\dfrac{5}{x^{-3}}$
$= 5x^3$

e) $\dfrac{x^{-3}}{5}$
$= \dfrac{1}{5x^3}$

f) $\dfrac{p^4}{q^{-3}}$
$= p^4q^3$

g) $x^3.y^{-4}$
$= \dfrac{x^3}{y^4}$

h) $\dfrac{4}{2^{-1}}$
$= 4 \times 2$
$= 8$

i) 4.2^{-1}
$= \dfrac{4}{2}$
$= 2$

j) $5^{-3}x$
$= \dfrac{x}{5^3}$

k) $\dfrac{1}{(5p)^{-2}}$
$= (5p)^2$
$= 25p^2$

l) $\dfrac{1}{5p^{-2}}$
$= \dfrac{p^2}{5}$

m) $= \dfrac{x^{-3}}{y^{-2}}$
$= \dfrac{y^2}{x^3}$

n) $\dfrac{(2xy)^{-2}}{x^{-3}}$
$= \dfrac{x^3}{(2xy)^2}$
$= \dfrac{x^3}{4x^2y^2}$
$= \dfrac{x}{4y^2}$

o) $\left(-2x^{-2}y^{-3}\right)^3$
$= -8x^{-6}y^{-9}$
$= \dfrac{-8}{x^6y^9}$

Exercise 2 number 1 is on page **277**

2)

a) $\left(3x^2y^4\right)^3 \times 2xy^{-2}$
$= 27x^6y^{12} \times 2xy^{-2}$
$= 54x^7y^{10}$

b) $\left(-5x^{-2}y^3\right)^2 \div 10xy^{-2}$
$= \dfrac{25x^{-4}y^6}{10xy^{-2}}$
$= \dfrac{5y^6 \times y^2}{2x^4 \times x}$
$= \dfrac{5y^8}{2x^5}$

c) $\left(-6p^2r^3\right)\left(-2p^{-1}r^3\right)^2$
$= \left(-6p^2r^3\right)\left(4p^{-2}r^6\right)$
$= -24p^0r^9$
$= -24r^9$

d) $\dfrac{x^3y^{-3}z^7}{x^{-1}y^2z^{-4}}$
$= \dfrac{x^3 \times x^1 \times z^7 \times z^4}{y^2 \times y^3}$
$= \dfrac{x^4z^{11}}{y^5}$

e) $\dfrac{\left(7a^{-3}b^4\right)^2}{m^{-8}n^9}$
$= \dfrac{49a^{-6}b^8}{m^{-8}n^9}$
$= \dfrac{49b^8m^8}{a^6n^9}$

f) $\left(\dfrac{5p^3q^{-2}}{r^{-5}}\right)^2$
$= \dfrac{\left(5p^3q^{-2}\right)^2}{\left(r^{-5}\right)^2}$
$= \dfrac{25p^6q^{-4}}{r^{-10}}$
$= \dfrac{25p^6r^{10}}{q^4}$

g) $\dfrac{(3x)^{-1}}{(5y)^{-2}}$
$= \dfrac{(5y)^2}{3x}$
$= \dfrac{25y^2}{3x}$

h) $\dfrac{1}{2x^{-1}} + 2^{-1}.x - (-2)^0 x$
$= \dfrac{x}{2} + \dfrac{x}{2} - x$
$= \dfrac{x + x - 2x}{2}$
$= 0$

i) $\dfrac{a+b}{a^{-1}+b^{-1}}$
$= (a+b) \div \left(\dfrac{1}{a} + \dfrac{1}{b}\right)$
$= (a+b) \div \left(\dfrac{b+a}{ab}\right)$
$= \dfrac{\cancel{a+b}}{1} \times \dfrac{ab}{\cancel{a+b}}$
$= ab$

j) $\left(\dfrac{x^3 + 2x^3}{x \times x}\right)^2$
$= \dfrac{\left(x^3 + 2x^3\right)^2}{\left(x^2\right)^2}$
$= \dfrac{\left(3x^3\right)^2}{x^4}$
$= \dfrac{9x^6}{x^4}$
$= 9x^2$

Exercise 2 number 2 is on page **277**

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Exercise 3 Solutions:

1)

a) $3^x = 3^1$
$\therefore x = 1$

b) $3^x = 3^2$
$x = 2$

c) $3^{3x} = 3^3$
$\therefore 3x = 3$
$\therefore x = 1$

d) $5^x = 5^3$
$\therefore x = 3$

e) $7^x = 1$
$\therefore 7^x = 7^0$
$\therefore x = 0$

f) $7^{x+1} = 7^2$
$\therefore x + 1 = 2$
$\therefore x = 1$

g) $4^{3x} = 64$
$\left(2^2\right)^{3x} = 2^6$
$\therefore 2^{6x} = 2^6$
$\therefore 6x = 6$
$\therefore x = 1$

h) $11^{x-5} = 11^0$
$\therefore x - 5 = 0$
$\therefore x = 5$

i) $3.13^x = 39$
$\therefore 13^x = 13^1$
$\therefore x = 1$

j) $3^x.9 = 27$
$\therefore 3^x = 3$
$\therefore x = 1$

k) $8^x = 64$
$\therefore 8^x = 8^2$
$\therefore x = 2$

l) $37^x = 1$
$\therefore 37^x = 37^0$
$\therefore x = 0$

m) $\therefore \left(2^3\right)^x = 2^4$
$\therefore 2^{3x} = 2^4$
$\therefore 3x = 4$
$\therefore x = \frac{4}{3}$

n) $\left(3^3\right)^x = \frac{1}{3^3}$
$\therefore 3^{3x} = 3^{-3}$
$\therefore 3x = -3$
$\therefore x = -1$

Exercise 3 number 1 is on page **278**

2)

a) $3^{n-5} = 3^{-2}$
$\therefore n - 5 = -2$
$\therefore n = 3$

b) $11^k = 11^{-2}$
$\therefore k = -2$

c) $5^{p-3} = 5^{-2}$
$\therefore p - 3 = -2$
$\therefore p = 1$

d) $7^{-a} = 7^2$
$\therefore a = -2$

e) $\left(2^2\right)^{2r-3} = 2^{-2}$
$\therefore 2^{4r-6} = 2^{-2}$
$\therefore 4r - 6 = -2$
$\therefore 4r = 4$
$\therefore r = 1$

f) $\left(5^2\right)^{y-4} = 5^{-2}$
$\therefore 5^{2y-8} = 5^{-2}$
$\therefore 2y - 8 = -2$
$\therefore 2y = 6$
$\therefore y = 3$

Exercise 3 number 2 is on page **278**

3)

a) $\frac{1}{49^x} = 343$
$\therefore \left(7^{-2}\right)^x = 7^3$
$\therefore 7^{-2x} = 7^3$
$\therefore -2x = 3$
$\therefore x = \frac{3}{-2}$

b) $\left(\frac{1}{7}\right)^x = \left(\frac{1}{49}\right)$
$\therefore \left(\frac{1}{7}\right)^x = \left(\frac{1}{7^2}\right)$
$\therefore \left(\frac{1}{7}\right)^x = \left(\frac{1}{7}\right)^2$
$\therefore x = 2$

c) $0,4^x = 0,064$
$\therefore \left(\frac{2}{5}\right)^x = \left(\frac{8}{125}\right)$
$\therefore \left(\frac{2}{5}\right)^x = \left(\frac{2^3}{5^3}\right)$
$\therefore \left(\frac{2}{5}\right)^x = \left(\frac{2}{5}\right)^3$
$\therefore x = 3$

d) $2^{x+1} = 4^{x-3}$
$\therefore 2^{x+1} = \left(2^2\right)^{x-3}$
$\therefore 2^{x+1} = 2^{2x-6}$
$\therefore x + 1 = 2x - 6$
$\therefore -x = -7$
$\therefore x = 7$

e) $2^x.2^{x+1} = 8$
$\therefore 2^{x+1+x} = 2^3$
$\therefore 2^{2x+1} = 2^3$
$\therefore 2x + 1 = 3$
$\therefore 2x = 2$
$\therefore x = 1$

f) $3^{3x} \times 4 = 3^{2x} \times 36$
$\therefore \frac{3^{3x}}{3^{2x}} = \frac{36}{4}$
$\therefore 3^{3x-2x} = 9$
$\therefore 3^x = 3^2$
$\therefore x = 2$

Exercise 3 number 3 is on page **278**

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4)

a) $7^{x+5}=343$

$\therefore 7^{x+5}=7^3$

$\therefore x+5=3$

$\therefore x=-2$

b) $3^{2x-3}=\frac{1}{27}$

$\therefore 3^{2x-3}=3^{-3}$

$\therefore 2x-3=-3$

$\therefore 2x=0$

$\therefore x=0$

c) $5(3)^{2x-2}=45$

$\therefore (3)^{2x-2}=9$

$\therefore 3^{2x-2}=3^2$

$\therefore 2x-2=2$

$\therefore 2x=4$

$\therefore x=2$

d) $16\left(2^{x-3}\right)=8$

$\therefore 2^{x-3}=2^{-1}$

$\therefore x-3=-1$

$\therefore x=2$

e) $121^{x+2}=\frac{1}{11^{3x+1}}$

$\therefore \left(11^2\right)^{x+2}=11^{-(3x+1)}$

$\therefore 11^{2x+4}=11^{-3x-1}$

$\therefore 2x+4=-3x-1$

$\therefore 5x=-5$

$\therefore x=-1$

f) $25\left(\frac{1}{5}\right)^{x+2}=125$

$\therefore \left(5^{-1}\right)^{x+2}=5$

$\therefore 5^{-x-2}=5^1$

$\therefore -x-2=1$

$\therefore -x=3$

$\therefore x=-3$

g) $6^{\frac{x}{2}}=6^{-2}$

$\therefore \frac{x}{2}=-2$

$\therefore x=-4$

Exercise 3 number 4 is on page **278**

Exercise 4 Solutions:

1)

a) $2,3\times10^3$
$= 2\ 300$

b) $2,3\times10^{-3}$
$= 0,0023$

c) $-3,54\times10^5$
$= -354\ 000$

d) $-3,54\times10^{-5}$
$= -0,0000354$

e) $5,34085\times10^4$
$= 53\ 408,5$

f) $5,34085\times10^{-4}$
$= 0,000534085$

g) $-2,035\times10^3$
$= -\ 2\ 035$

h) $-2,035\times10^{-3}$
$= -\ 0,002035$

i) $1,3005\times10^2$
$= 130,05$

j) $1,3005\times10^{-2}$
$= 0,013005$

k) 5×10^5
$= 500\ 000$

l) 5×10^{-5}
$= 0,00005$

Exercise 4 number 1 is on page **278**

2)

a) $1,203\times10^6$

b) $3,54\times10^{-5}$

c) $1,325\times10^{-4}$

d) 5×10^{-7}

e) $1,2003\times10^9$

f) $5,65\times10^{-6}$

g) $3,5\times10^{-7}$

h) $5,5002\times10^4$

i) $5,053\times10^{-5}$

j) $8,52\times10^{14}$

k) $6,02301\times10^{11}$

l) $5,089\times10^{-10}$

Exercise 4 number 2 is on page **278**

Exercise 5 Solutions:

1)

a) $\left(4\times10^8\right)\times\left(5\times10^{-3}\right)$

$=20\times10^5$

$=2\times10^6$

b) $\frac{36\times10^8}{18\times10^3}$

$=2\times10^5$

c) $\left(1,5\times10^3\right)\times\left(4\times10^5\right)$

$=6\times10^8$

d) $\frac{24\times10^{12}}{3\times10^{-4}}$

$=8\times10^{16}$

e) $\left(5\times10^{-5}\right)\times\left(7\times10^{-4}\right)$

$=35\times10^{-9}$

$=3,5\times10^{-8}$

f) $\frac{-12\times10^{-4}}{3\times10^{-7}}$

$=-4\times10^3$

g) $\left(3,5\times10^{-3}\right)\times\left(5\times10^{11}\right)$

$=17,5\times10^8$

$=1,75\times10^9$

h) $\frac{-24\times10^{-4}}{-8\times10^7}$

$=3\times10^{-11}$

Exercise 5 number 1 is on page **278**

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2)

a) $5{,}3\times10^5+3\times10^5$
$=8{,}3\times10^5$

b) $2{,}8\times10^{15}-2\times10^{14}$
$=2{,}8\times10^{15}-0{,}2\times10^{15}$
$=2{,}6\times10^{15}$

c) $5\times10^5+3\times10^8$
$=5\times10^5+3000\times10^5$
$=3005\times10^5$
$=3{,}005\times10^8$

d) $-3{,}5\times10^{-10}+4\times10^{-11}$
$=-3{,}5\times10^{-10}+0{,}4\times10^{-10}$
$=-3{,}1\times10^{-10}$

e) $-5{,}2\times10^{-12}+\left(-4{,}5\times10^{-13}\right)$
$=-5{,}2\times10^{-12}-0{,}45\times10^{-12}$
$=-5{,}65\times10^{-12}$

Exercise 5 number 2 is on page 279

Mixed Exercise Solutions:

1)

a) $-2a^4b^6\times-5ab^2$
$=10a^5b^8$

b) $\dfrac{-6x^2y^3}{9x^4y^2}$
$=\dfrac{-2y}{3x^2}$

c) $5a^{-2}\times3b$
$=15a^{-2}b$
$=\dfrac{15b}{a^2}$

d) $4x^{-3}.x^4y^2\times-5x^{-4}$
$=-20x^{-3+4-4}y^2$
$=-20x^{-3}y^2$
$=\dfrac{-20y^2}{x^3}$

e) $(5x)^{-2}\times5x^{-2}$
$=5^{-2}x^{-2}\times5x^{-2}$
$=5^{-2+1}x^{-2-2}$
$=5^{-1}x^{-4}$
$=\dfrac{1}{5x^4}$

f) $5a^0b^8c\times-3b^{-5}c$
$=-15b^{8-5}c^{1+1}$
$=-15b^3c^2$

g) $\dfrac{3x^{-3}}{6y}$
$=\dfrac{1}{2x^3y}$

h) $(-1)^{50}-(-1)^{51}$
$=1-(-1)$
$=1+1$
$=2$

i) $\dfrac{2pq^2}{-8p^{-2}q}$
$=\dfrac{p^{1+2}q^{2-1}}{-4}$
$=\dfrac{p^3q}{-4}$

j) $\left(\dfrac{-3a^{-1}}{a^{-4}b^3}\right)^3$
$=\dfrac{-3^3a^{-3}}{a^{-12}b^9}$
$=\dfrac{-27a^{-3+12}}{b^9}$
$=\dfrac{-27a^9}{b^9}$

k) $\dfrac{2^{-1}x^{-2}}{3x^3y^{-1}}$
$=\dfrac{y}{2\times3x^{3+2}}$
$=\dfrac{y}{6x^5}$

l) $\left(\dfrac{-2x^{-1}y}{-3x^{-2}y^{-2}}\right)^2$
$=\dfrac{4x^{-2}y^2}{9x^{-4}y^{-4}}$
$=\dfrac{4x^{-2+4}y^{2+4}}{9}$
$=\dfrac{4x^2y^6}{9}$

m) $3^{-1}+5^{-1}$
$=\dfrac{1}{3}+\dfrac{1}{5}\rightarrow \text{LCD}=15$
$=\dfrac{5+3}{15}$
$=\dfrac{8}{15}$

n) $\dfrac{5a^0}{b}+b^{-1}+\dfrac{b^{-2}}{b^{-1}}$
$=\dfrac{5(1)}{b}+\dfrac{1}{b}+\dfrac{b^1}{b^2}$
$=\dfrac{5}{b}+\dfrac{1}{b}+\dfrac{1}{b}$
$=\dfrac{7}{b}$

o) $\left[\left(3x^2y^{-2}\right)^0\left(3x^2y^{-2}\right)^{-2}\right]^{-2}$
$=\left(3x^2y^{-2}\right)^0\left(3x^2y^{-2}\right)^4$
$=1\left(3^4x^8y^{-8}\right)$
$=\dfrac{81x^8}{y^8}$

p) $\dfrac{x+1}{x^{-1}+1}$
$=\dfrac{x+1}{\frac{1}{x}+1}$
$=(x+1)\div\left(\dfrac{1+x}{x}\right)$
$=\cancel{1+x}\times\dfrac{x}{\cancel{1+x}}$
$=x$

q) $\left(2x^0\right)\left(4x^3\right)^0$
$[2(1)](1)$
$=2$

r) $\dfrac{(-1x)^{101}}{(-1x)^{-100}}$
$=-1x^{101}(-1x)^{100}$
$=-1x^{101}\left(1x^{100}\right)$
$=-1x^{201}$

The Mixed Exercise number 1 is on page 279

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2)

a)
$$2^{x-2}=2$$
$$\therefore x-2=1$$
$$\therefore x=3$$

b)
$$2^x=\frac{1}{32}$$
$$\therefore 2^x=2^{-5}$$
$$\therefore x=-5$$

c)
$$2\times 3^{x+1}-54=0$$
$$\therefore 2\times 3^{x+1}=54$$
$$\therefore 3^{x+1}=27$$
$$\therefore 3^{x+1}=3^3$$
$$\therefore x+1=3$$
$$\therefore x=2$$

d)
$$\left(\frac{1}{121}\right)^x=1331$$
$$\therefore \left(11^{-2}\right)^x=11^3$$
$$\therefore 11^{-2x}=11^3$$
$$\therefore -2x=3$$
$$\therefore x=\frac{3}{-2}$$

e)
$$343^a=49^{a+1}$$
$$\therefore \left(7^3\right)^a=\left(7^2\right)^{a+1}$$
$$\therefore 7^{3a}=7^{2a+2}$$
$$\therefore 3a=2a+2$$
$$\therefore a=2$$

f)
$$\frac{1}{2}\left(\frac{1}{2}\right)^x=8$$
$$\therefore 2^{-1}\left(2^{-1}\right)^x=2^3$$
$$\therefore 2^{-1}\times 2^{-x}=2^3$$
$$\therefore 2^{-1-x}=2^3$$
$$\therefore -1-x=3$$
$$\therefore x=-4$$

g)
$$2\left(2^2\right)^x=0,5$$
$$\therefore 2\times 2^{2x}=2^{-1}$$
$$\therefore 2^{1+2x}=2^{-1}$$
$$\therefore 1+2x=-1$$
$$\therefore 2x=-2$$
$$\therefore x=-1$$

h)
$$3\left(2^2\right)^x=12$$
$$\therefore \left(2^2\right)^x=4$$
$$\therefore 2^{2x}=2^2$$
$$\therefore 2x=2$$
$$\therefore x=1$$

i)
$$3.7^{r-1}-1=1028$$
$$\therefore 3.7^{r-1}=1029$$
$$\therefore 7^{r-1}=343$$
$$\therefore 7^{r-1}=7^3$$
$$\therefore r-1=3$$
$$\therefore r=4$$

j)
$$3^{256x}+4=5$$
$$\therefore 3^{256x}=1$$
$$\therefore 3^{256x}=3^0$$
$$\therefore 256x=0$$
$$\therefore x=0$$

k)
$$6^{3x}=\frac{1}{36}$$
$$\therefore 6^{3x}=6^{-2}$$
$$\therefore 3x=-2$$
$$\therefore x=\frac{-2}{3}$$

l)
$$\frac{2^x}{3^x}=\frac{4}{9}$$
$$\therefore \left(\frac{2}{3}\right)^x=\left(\frac{2}{3}\right)^2$$
$$\therefore x=2$$

The Mixed Exercise number 2 is on page **279**

3)

a) 3×10^8 m/s **b)** $1,6726219\times 10^{-27}$ kg **c)** $5,972\times 10^{24}$ kg **d)** $9,1096\times 10^{-28}$ g

The Mixed Exercise number 3 is on page **279**

4)

a)
$$1,1\times 10^{-6}\times 5\times 10^{-2}$$
$$=11\times 10^{-7}\times 5\times 10^{-2}$$
$$=55\times 10^{-9}$$
$$=5,5\times 10^{-8}$$

b)
$$5,5\times 10^{-8}$$
$$=0,000000055$$

The Mixed Exercise number 4 is on page **279**

5) $\mathbf{5,3\times 10^{-4}+1,4\times 10^{-3}}$

a)
$$5,3\times 10^{-4}+1,4\times 10^{-3}$$
$$=0,53\times 10^{-3}+1,4\times 10^{-3}$$
$$=1,93\times 10^{-3}$$

b)
$$1,93\times 10^{-3}$$
$$=0,00193$$

The Mixed Exercise number 5 is on page **279**

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Chapter 6 – Number Patterns

Number Patterns with a Constant Difference (from pages 56 and 57)

Exercise 1:

1) For each of the number patterns below, write down the next three terms.

a) $6 ; 9 ; 12 ; 15 ; _ ; _ ; _$

b) $\frac{1}{2} ; 1 ; \frac{3}{2} ; 2 ; _ ; _ ; _$

c) $2 ; 5 ; 8 ; _ ; _ ; _$

d) $-4 ; -8 ; -12 ; _ ; _ ; _$

e) $1 ; \frac{2}{3} ; \frac{1}{3} ; 0 ; _ ; _ ; _$

f) $-15 ; -9 ; -3 ; _ ; _ ; _$

g) $-2 ; -5 ; -8 ; _ ; _ ; _$

h) $2 ; \frac{11}{4} ; \frac{7}{2} ; _ ; _ ; _$

i) $15 ; 10 ; 5 ; _ ; _ ; _$

Solutions to Exercise 1 number 1 are on page **288**

2) For each of the number patterns in question 1 above, write down the constant difference and a general mathematical rule to determine any term in each pattern.

Solutions to Exercise 1 number 2 are on page **288**

3) For each of the number patterns in question 1 above, use your rule to write down the 28th term.

Solutions to Exercise 1 number 2 are on page **288**

4) Examine the pattern 7 ; 12 ; 17 ; 22 ; … :

a) Determine a formula for the general rule for the nth term of the pattern.

b) Determine the 58th term of the pattern.

c) Which term of the pattern is equal to 417?

Solutions to Exercise 1 number 2 are on page **288**

Number Patterns with a Constant Ratio (from page 58)

Exercise 2:

1) For each of the number patterns below, write down the next three terms.

a) $3 ; 6 ; 12 ; _ ; _ ; _$

b) $\frac{1}{2} ; 1; 2; 4; _ ; _ ; _$

c) $2 ; 4 ; 8 ; _ ; _ ; _$

d) $-4 ; 8 ; -16 ; _ ; _ ; _$

e) $\frac{1}{3} ; \frac{1}{6} ; \frac{1}{12} ; _ ; _ ; _$

f) $-3 ; 6 ; -12 ; _ ; _ ; _$

g) $288 ; -144 ; 72 ; _ ; _ ; _$

h) $22 ; 11 ; \frac{11}{2} ; _ ; _ ; _$

i) $3 ; 9 ; 27 ; _ ; _ ; _$

Solutions to Exercise 2 number 1 are on page **288**

2) For each of the number patterns in question 1 above, write down the constant ratio and a general mathematical rule to determine any term in each pattern.

Solutions to Exercise 2 number 2 are on page **289**

3) For each of the number patterns in question 1 above, use your rule to write down the 9th term.

Solutions to Exercise 2 number 3 are on page **289**

Number Patterns Without a Constant Difference or Ratio (from pages 59 and 60)

Exercise 3:

1) Consider the pattern 4 ; 10 ; 18 ; …

a) Complete the pattern below by filling in the missing numbers:

$1(1+3) = \ldots$

$2(2+3) = \ldots$

$3(3+3) = \ldots$

$4(4+3) = \ldots$

$5(5+3) = \ldots$

$6(6+3) = \ldots$

b) Using your answers above, determine a general mathematical formula for the nth term of the pattern.

c) Determine the 20th term in the pattern.

Solutions to Exercise 3 number 1 are on page **289**

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2) Consider the pattern 4 ; 7; 12 ; …

a) Complete the pattern below by filling in the missing numbers:

$1^2 + 3 = ...$ $\qquad$ $4^2 + 3 = ...$

$2^2 + 3 = ...$ $\qquad$ $5^2 + 3 = ...$

$3^2 + 3 = ...$ $\qquad$ $6^2 + 3 = ...$

b) Using your answers above, determine a general mathematical formula for the nth term of the pattern.

c) Determine the 20th term in the pattern.

Solutions to Exercise 3 number 2 are on page **289**

Mixed Exercise:

1) For each of the number patterns below, write down the next three terms.

a) 6 ; 9 ; 12 ; 15 ; _ ; _ ; _

b) $\frac{1}{2}; -\frac{1}{4}; \frac{1}{8}; -\frac{1}{16}$; _ ; _ ; _

c) 2 ; 5 ; 8 ; _ ; _ ; _

d) 4 ; 6 ; 9 ; 13 ; 18 ; _ ; _ ; _

e) $1; \frac{1}{2}; \frac{1}{3}; \frac{1}{4}$; _ ; _ ; _

f) 1 ; 4 ; 9 ; _ ; _ ; _

g) 1 ; 2 ; 3 ; 5 ; 8 ; 13 ; _ ; _ ; _

h) $1; 2\frac{1}{2}; 4; \frac{11}{2}$; _ ; _ ; _

i) 3 ; 5 ; 5 ; 8 ; 7 ; 11 ; 9 ; _ ; _ ; _

Solutions to the Mixed Exercise number 1 are on page **290**

2) Examine the figures below and answer the questions which follow:

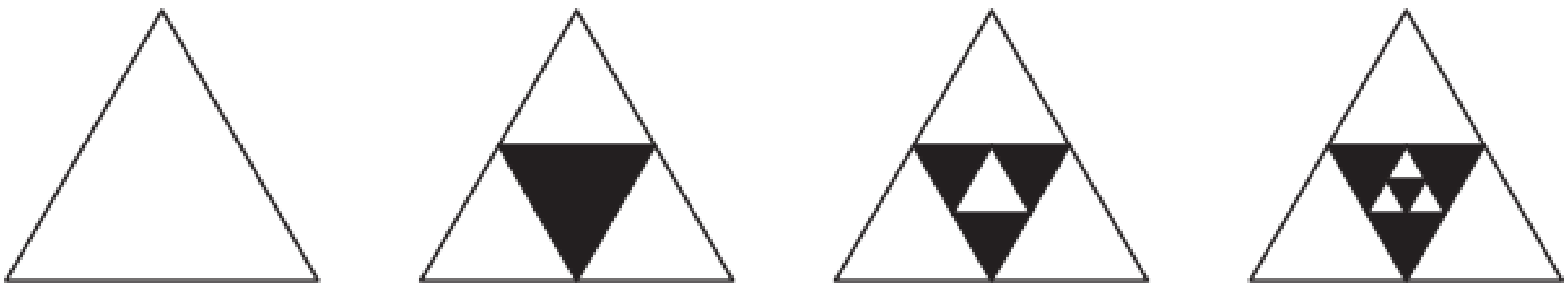

Figure 1 $\qquad$ Figure 2 $\qquad$ Figure 3 $\qquad$ Figure 4

a) Complete the table below:

Figure (n)	**1**	**2**	**3**	**4**	**5**	**6**
Number of Triangles	1	4	7	10		

b) Determine a general mathematical rule to determine the number of triangles in the nth figure.

c) Which figure will have 67 triangles in it?

Solutions to the Mixed Exercise number 2 are on page **290**

3) Examine the figures below:

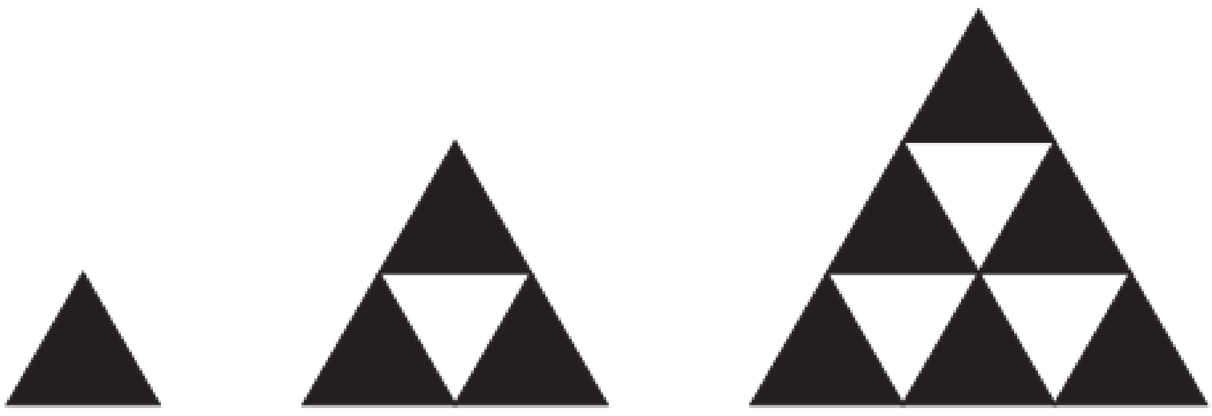

Figure 1 $\qquad$ Figure 2 $\qquad$ Figure 3

a) Complete the patterns below by filling in the missing numbers:

$(1^2 + 1) \div 2 = ...$ $\qquad$ $(1^2 - 1) \div 2 = ...$

$(2^2 + 2) \div 2 = ...$ $\qquad$ $(2^2 - 2) \div 2 = ...$

$(3^2 + 3) \div 2 = ...$ $\qquad$ $(3^2 - 3) \div 2 = ...$

$(4^2 + 4) \div 2 = ...$ $\qquad$ $(4^2 - 4) \div 2 = ...$

b) Complete the table below:

Figure (n)	**1**	**2**	**3**	**4**	**10**	***n***
Number of triangles						
Number of black triangles						
Number of white triangles						

Solutions to the Mixed Exercise number 3 are on page **290**

4) Fill in the table below and use it to determine the value of the sum of the digits of $2^{2007} \times 5^{2008}$.

	$2^1 \times 5^1$	$2^2 \times 5^2$	$2^3 \times 5^3$	$2^4 \times 5^4$	$2^5 \times 5^5$	$2^6 \times 5^6$
Answer						
Sum of digits						

Solutions to the Mixed Exercise number 4 are on page **290**

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Chapter 6 – Number Patterns (Solutions)

Exercise 1 Solutions:

1)

a) 6 ; 9 ; 12 ; 15 ; **18 ; 21 ; 24**

b) $\frac{1}{2}$; 1 ; $\frac{3}{2}$; 2 ; $\mathbf{\frac{5}{2}}$; **3** ; $\mathbf{\frac{7}{2}}$

c) 2 ; 5 ; 8 ; **11 ; 14 ; 17**

d) –4 ; –8 ; –12 ; **–16 ; –20 ; –24**

e) 1 ; $\frac{2}{3}$; $\frac{1}{3}$; 0 ; $\mathbf{-\frac{1}{3}}$; $\mathbf{-\frac{2}{3}}$; **–1**

f) –15 ; –9 ; –3 ; **3 ; 9 ; 15**

g) –2 ; –5 ; –8 ; **–11 ; –14 ; –17**

h) 2 ; $\frac{11}{4}$; $\frac{7}{2}$; $\mathbf{\frac{17}{4}}$; **5** ; $\mathbf{\frac{23}{4}}$

i) 15 ; 10 ; 5 ; **0 ; –5 ; –10**

Exercise 1 number 1 is on page **286**

2)

a) $d = 3$
$T_n = 3n + 3$

b) $d = \frac{1}{2}$
$T_n = \frac{1}{2}n + 0$

c) $d = 3$
$T_n = 3n - 1$

d) $d = -4$
$T_n = -4n + 0$

e) $d = -\frac{1}{3}$
$T_n = -\frac{1}{3}n + \frac{4}{3}$

f) $d = 6$
$T_n = 6n - 21$

g) $d = -3$
$T_n = -3n + 1$

h) $d = \frac{3}{4}$
$T_n = \frac{3}{4}n + \frac{5}{4}$

i) $d = -5$
$T_n = -5n + 20$

Exercise 1 number 2 is on page **286**

3)

a) $T_{28} = 3(28) + 3$
$= 87$

b) $T_{28} = \frac{1}{2}(28)$
$= 14$

c) $T_{28} = 3(28) - 1$
$= 83$

d) $T_{28} = -4(28)$
$= -112$

e) $T_{28} = -\frac{1}{3}(28) + \frac{4}{3}$
$= -8$

f) $T_{28} = 6(28) - 21$
$= 147$

g) $T_{28} = -3(28) + 1$
$= -83$

h) $T_{28} = \frac{3}{4}(28) + \frac{5}{4}$
$= \frac{89}{4}$

i) $T_{28} = -5(28) + 20$
$= -120$

Exercise 1 number 3 is on page **286**

4)

a) $d = 5$
$\therefore T_n = 5n + c$
$\therefore T_n = 5n + 2$

b) $T_{58} = 5(58) + 2$
$= 292$

c) $T_n = 417$
$\therefore 417 = 5n + 2 \rightarrow$ subtract 2 from both sides
$\therefore 415 = 5n \rightarrow$ divide both sides by 5
$\therefore 83 = n$
$\therefore T_{83} = 417$

Exercise 1 number 4 is on page **286**

Exercise 2 Solutions:

1)

a) 3 ; 6 ; 12 ; **24 ; 48 ; 96**

b) $\frac{1}{2}$; 1; 2; 4; **8 ; 16 ; 32**

c) 2 ; 4 ; 8 ; **16 ; 32 ; 64**

d) –4 ; 8 ; –16 ; **32 ; –64 ; 128**

e) $\frac{1}{3}$; $\frac{1}{6}$; $\frac{1}{12}$; $\mathbf{\frac{1}{24}}$; $\mathbf{\frac{1}{48}}$; $\mathbf{\frac{1}{96}}$

f) –3 ; 6 ; –12 ; **24 ; –48 ; 96**

g) 288; –144 ; 72 ; **–36 ; 18 ; –9**

h) 22 ; 11 ; $\frac{11}{2}$; $\mathbf{\frac{11}{4}}$; $\mathbf{\frac{11}{8}}$; $\mathbf{\frac{11}{16}}$

i) 3 ; 9 ; 27 ; **81 ; 243 ; 729**

Exercise 2 number 1 is on page **286**

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2)

a) $r = 2$

$T_n = 3(2)^{n-1}$

b) $r = 2$

$T_n = \frac{1}{2}(2)^{n-1}$

c) $r = 2$

$T_n = 2(2)^{n-1}$

d) $r = -2$

$T_n = -4(-2)^{n-1}$

e) $r = \frac{1}{2}$

$T_n = \frac{1}{3}\left(\frac{1}{2}\right)^{n-1}$

f) $r = -2$

$T_n = -3(-2)^{n-1}$

g) $r = -\frac{1}{2}$

$T_n = 288\left(-\frac{1}{2}\right)^{r-1}$

h) $r = \frac{1}{2}$

$T_n = 22\left(\frac{1}{2}\right)^{r-1}$

i) $r = 3$

$T_n = 3(3)^{n-1}$

Exercise 2 number 2 is on page **286**

3)

a) $T_9 = 3(2)^8$
$= 768$

b) $T_9 = \frac{1}{2}(2)^8$
$= 128$

c) $T_9 = 2(2)^8$
$= 512$

d) $T_9 = -4(-2)^8$
$= -1024$

e) $T_9 = \frac{1}{3}\left(\frac{1}{2}\right)^8$
$= \frac{1}{768}$

f) $T_9 = -3(-2)^8$
$= -768$

g) $T_9 = 288\left(-\frac{1}{2}\right)^8$
$= \frac{9}{8}$

h) $T_9 = 22\left(\frac{1}{2}\right)^8$
$= \frac{11}{128}$

i) $T_8 = 3(3)^8$
$= 19\,683$

Exercise 2 number 2 is on page **286**

<u>Exercise 3 Solutions</u>:

1)

a) $1(1+3) = 4$
$2(2+3) = 10$
$3(3+3) = 18$
$4(4+3) = 28$
$5(5+3) = 40$
$6(6+3) = 54$

b) $T_n = n(n+3)$

c) $T_{20} = 20(20+3)$
$= 20(23)$
$= 460$

Exercise 3 number 1 is on page **286**

2)

a) $1^2 + 3 = 4$
$2^2 + 3 = 7$
$3^2 + 3 = 12$
$4^2 + 3 = 19$
$5^2 + 3 = 28$
$6^2 + 3 = 39$

b) $T_n = n^2 + 3$

c) $T_{20} = 20^2 + 3$
$= 403$

Exercise 3 number 2 is on page **287**

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<u>Mixed Exercise Solutions</u>:

1)

a) 6 ; 9 ; 12 ; 15; **18 ; 21 ; 24**

b) $\frac{1}{2};-\frac{1}{4};\frac{1}{8};-\frac{1}{16};\mathbf{\frac{1}{32}};\ \mathbf{-\frac{1}{64}};\ \mathbf{\frac{1}{128}}$

c) 2 ; 5 ; 8 ; **11 ; 14 ; 17**

d) 4 ; 6 ; 9 ; 13 ; 18 ; **24** ; **31** ; **39**

e) $1;\ \frac{1}{2};\ \frac{1}{3};\ \frac{1}{4};\ \mathbf{\frac{1}{5}};\ \mathbf{\frac{1}{6}};\ \mathbf{\frac{1}{7}}$

f) 1 ; 4 ; 9 ; **16** ; **25** ; **36**

g) 1 ; 2 ; 3 ; 5 ; 8 ; 13 ; **21** ; **34** ; **55**

h) $1;\ 2\frac{1}{2};\ 4;\ \frac{11}{2};\ \mathbf{7};\ \mathbf{\frac{17}{2}};\ \mathbf{10}$

i) 3 ; 5 ; 5 ; 8 ; 7 ; 11 ; 9 ; **14** ; **12** ; **17**

The Mixed Exercise number 1 is on page **287**

2)

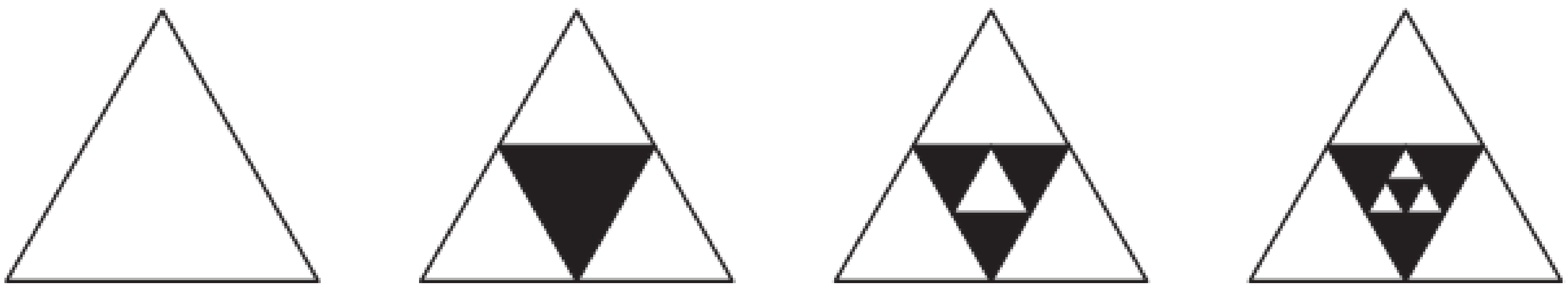

Figure 1 Figure 2 Figure 3 Figure 4

a)

Figure (n)	**1**	**2**	**3**	**4**	**5**	**6**
Number of Triangles	1	4	7	10	**13**	**16**

b) $d = 3$

$T_n = 3n + c$

$\therefore T_n = 3n - 2$

c) $T_n = 67$

$\therefore 67 = 3n - 2 \rightarrow$ add 2 to both sides

$\therefore 69 = 3n \rightarrow$ divide both sides by 3

$\therefore 23 = n$

$\therefore T_{23} = 67$

The Mixed Exercise number 2 is on page **287**

3)

a)

$(1^2 + 1) \div 2 = 1$

$(2^2 + 2) \div 2 = 3$

$(3^2 + 3) \div 2 = 6$

$(4^2 + 4) \div 2 = 10$

$(1^2 - 1) \div 2 = 0$

$(2^2 - 2) \div 2 = 1$

$(3^2 - 3) \div 2 = 3$

$(4^2 - 4) \div 2 = 6$

b)

Figure (n)	**1**	**2**	**3**	**4**	**10**	**n**
Number of triangles	1	4	9	16	100	n^2
Number of black triangles	1	3	6	10	55	$(n^2 + n) \div 2$
Number of white triangles	0	1	3	6	45	$(n^2 - n) \div 2$

The Mixed Exercise number 3 is on page **287**

4)

	$2^1 \times 5^1$	$2^2 \times 5^2$	$2^3 \times 5^3$	$2^4 \times 5^4$	$2^5 \times 5^5$	$2^6 \times 5^6$
Answer	10	100	1 000	10 000	100 000	1 000 000
Sum of digits	1	1	1	1	1	1

$2^{2007} \times 5^{2008}$

$= 2^2 \times 2^{2005} \times 5^3 \times 5^{2005}$

$= 2^2 \times 5^3 \times 2^{2005} \times 5^{2005}$

$= 2^2 \times 5^3 \times 2^{2005} \times 5^{2005}$

$= 500 \times 100000......$

$\therefore$ sum of digits = 5

The Mixed Exercise number 4 is on page **287**

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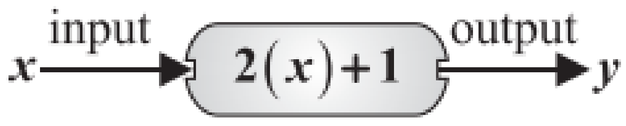
Chapter 7 – Functions and Relationships

Tables, Flow Diagrams and Functions (from pages 65 - 67)

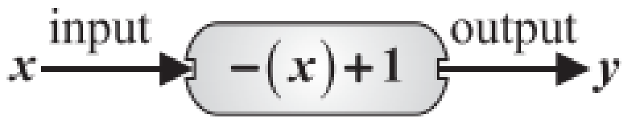
Mixed Exercise:

1) For each of the flow diagrams below, draw a table of the output value (y) for the input values (x): –3 ; –2 ; –1 ; 0 ; 1 ; 2 ; 3.

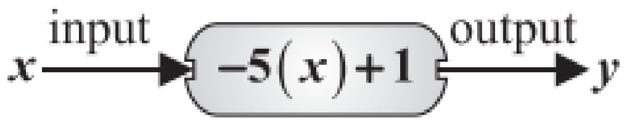
a)



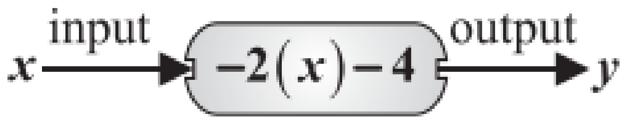
b)



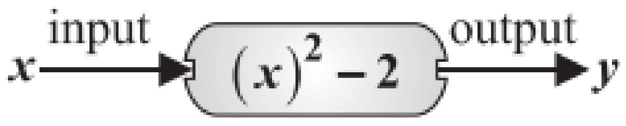
c)



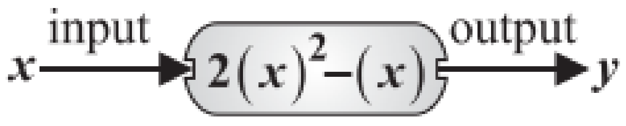
d)



e)



f)



Solutions to the Mixed Exercise number 1 are on page 292

2) Examine the flow diagram below and answer the question which follow.

a) Represent the flow diagram as an equation where x is the input value and (y) is the output value.
b) If the input value is 3, use your equation to determine the output value.

Solutions to the Mixed Exercise number 2 are on page 292

3) Examine the table below and answer the question which follow.

Input	–3	–2	–1	0	1	2	3
Output	10	5	2	1	2	5	10

a) Complete the pattern below:

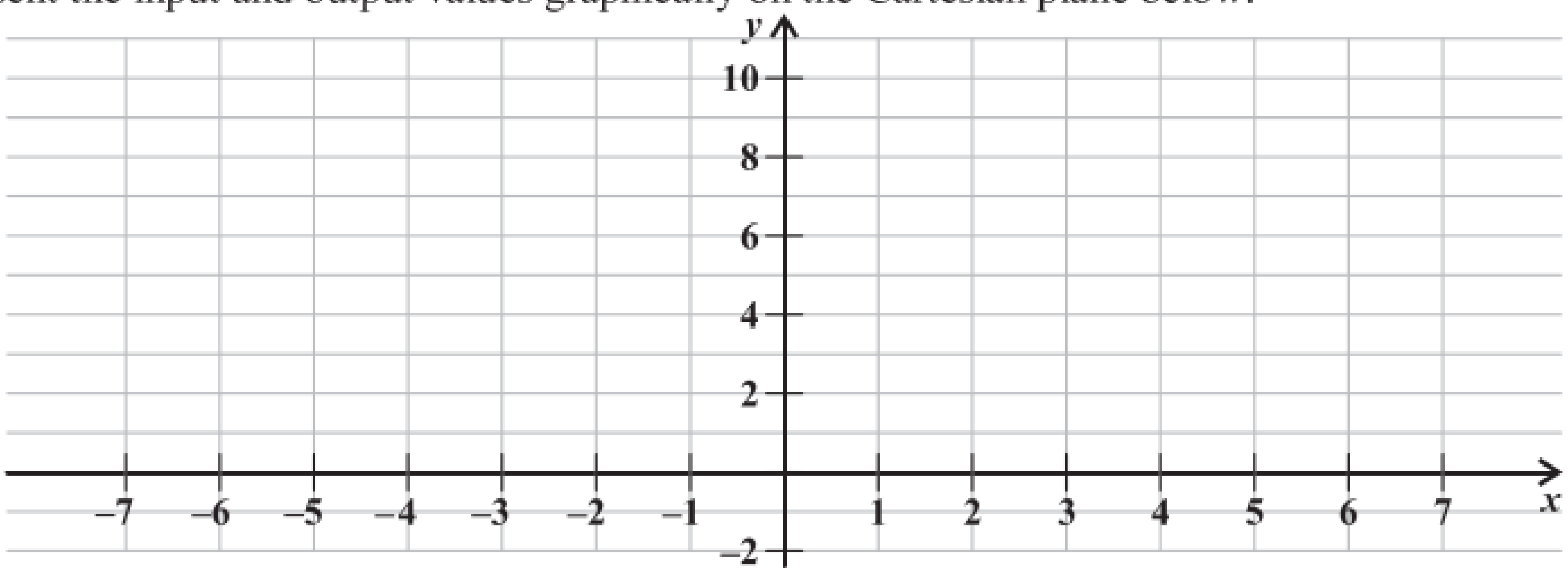
$(-3)^2 + 1 =$

$(-2)^2 + 1 =$

$(-1)^2 + 1 =$

$(0)^2 + 1 =$

b) Represent the input and output values graphically on the Cartesian plane below:



c) Determine an equation in terms of input (x) values and output (y) values for the table above.
d) Draw a flow diagram to represent your equation above.

Solutions to the Mixed Exercise number 3 are on page 292

4) Examine the Geometric pattern below:

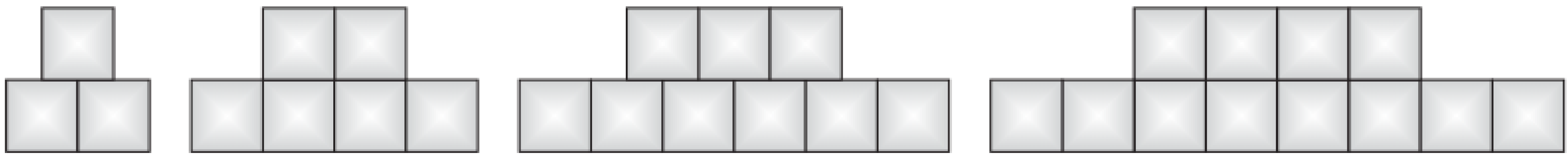


Figure 1 Figure 2 Figure 3 Figure 4

a) Represent the number of blocks in each figure in a table.
b) Represent the number of blocks in each figure as a formula where x is the figure and y is the number of blocks.
c) Represent the number of blocks in each of the above figures graphically on a Cartesian plane.

Solutions to the Mixed Exercise number 4 are on page 293

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Chapter 7 – Functions and Relationships (Solutions)

Mixed Exercise Solutions:

1)

a) $y = 2x + 1$

y	-3	-2	-1	0	1	2	3
x	$y=2(-3)+1$ -5	$y=2(-2)+1$ -3	$y=2(-1)+1$ -1	$y=2(0)+1$ 1	$y=2(1)+1$ 3	$y=2(2)+1$ 5	$y=2(3)+1$ 7

b) $y = -x + 1$

y	-3	-2	-1	0	1	2	3
x	$y=-(-3)+1$ 4	$y=-(-2)+1$ 3	$y=-(-1)+1$ 2	$y=-(0)+1$ 1	$y=-(1)+1$ 0	$y=-(2)+1$ -1	$y=-(3)+1$ -2

c) $y = -5x + 1$

y	-3	-2	-1	0	1	2	3
x	$y=-5(-3)+1$ 16	$y=-5(-2)+1$ 11	$y=-5(-1)+1$ 6	$y=-5(0)+1$ 1	$y=-5(1)+1$ -4	$y=-5(2)+1$ -9	$y=-5(3)+1$ -14

d) $y = -2x - 4$

y	-3	-2	-1	0	1	2	3
x	$y=-2(-3)-4$ 2	$y=-2(-2)-4$ 0	$y=-2(-1)-4$ -2	$y=-2(0)-4$ -4	$y=-2(1)-4$ -6	$y=-2(2)-4$ -8	$y=-2(3)-4$ -10

e) $y = x^2 - 2$

y	-3	-2	-1	0	1	2	3
x	$y=(-3)^2-2$ 7	$y=(-2)^2-2$ 2	$y=(-1)^2-2$ -1	$y=(0)^2-2$ -2	$y=(1)^2-2$ -1	$y=(2)^2-2$ 2	$y=(3)^2-2$ 7

f) $y = 2x^2 - x$

y	-3	-2	-1	0	1	2	3
x	$y=2(-3)^2-(-3)$ 21	$y=2(-2)^2-(-2)$ 10	$y=2(-1)^2-(-1)$ 3	$y=2(0)^2-(0)$ 0	$y=2(1)^2-(1)$ 1	$y=2(2)^2-(2)$ 6	$y=2(3)^2-(3)$ 15

The Mixed Exercise number 1 is on page **291**

2)

a) $y = x^2 \times 2 + 1$

$= 2x^2 + 1$

b) $y = 2(3)^2 + 1$

$= 19$

The Mixed Exercise number 1 is on page **291**

3)

a) Complete the pattern below:

$(-3)^2 + 1 = 10$

$(-2)^2 + 1 = 5$

$(-1)^2 + 1 = 2$

$(0)^2 + 1 = 1$

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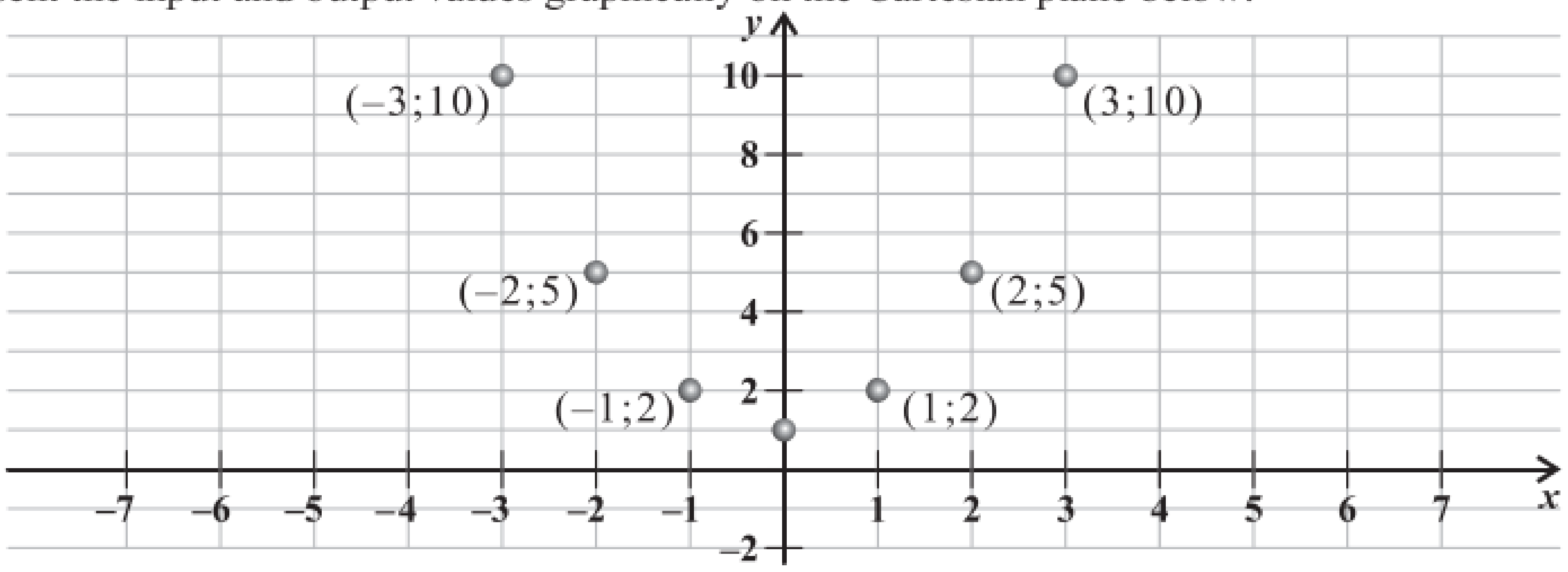
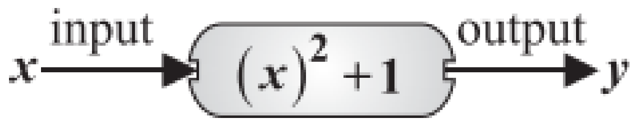
b) Represent the input and output values graphically on the Cartesian plane below:



c) $y = x^2 + 1$

d)



The Mixed Exercise number 3 is on page **291**

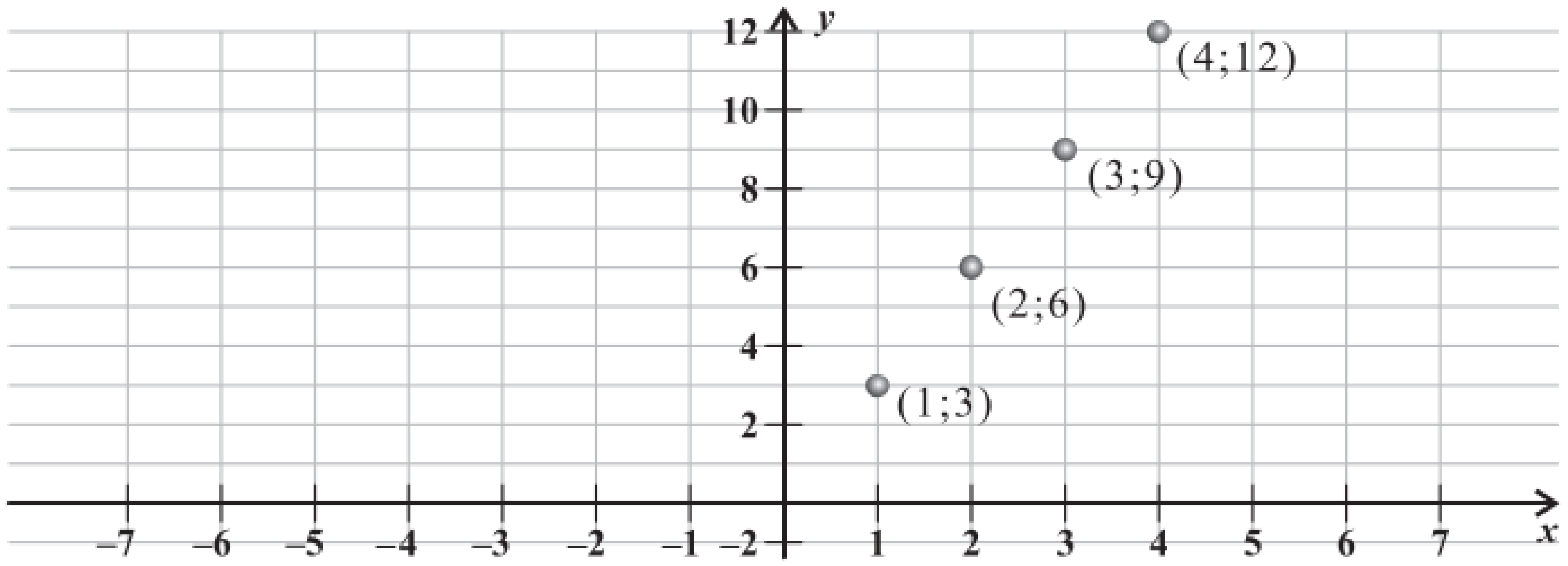
4)

a)

Figure	1	2	3	4
Blocks	**3**	**6**	**9**	**12**

b) $y = 3x$

c)



The Mixed Exercise number 4 is on page **291**

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Chapter 8 – Algebraic Expressions

Grade 8 Revision (from pages 69 and 72)

Exercise 1:

1) Write down the number of terms in each of the following:

a) $3x^2+11y$

b) $3x+2yx$

c) $3x\times 2\times 8m$

d) $8x+2y\times 7$

e) $\dfrac{8x+1}{3y+2}$

Solutions to Exercise 1 number 1 are on page **296**

2) In the expression $8x^2-4x+12$:

a) How many terms are there in the expression?

b) What is the coefficient of x?

c) What is the value of the constant term?

d) Write down the degree of the expression.

e) Evaluate the expression when $x=-1$.

Solutions to Exercise 1 number 2 are on page **296**

3) Simplify the following:

a) $8(x-3)-3(2x-3y)$

b) $2a(a-2b)-3b(-a-5b)$

c) $p(2-2q)-(p-5)(q)$

d) $2\left(3x^2+8x-4\right)+x(x+3)$

e) $(-2x)^2(x+3)-5+3(2x+1)$

Solutions to Exercise 1 number 3 are on page **296**

4)

a) Add $2x^2-5x+1$ and x^2-5x+1.

b) Subtract $3x^2-2x+4$ from $-2x^2+x+1$.

c) From $-5p^2-2q+4$ subtract $-2p^2-q+5$.

Solutions to Exercise 1 number 4 are on page **296**

5) Answer the following questions:

a) What must be added to 5 to give an answer of 8?

b) What must be added to 3 to give and answer of 5?

c) What must be added to $-5x^2+2x-4$ to give an answer of $3x^2+2x-9$?

Solutions to Exercise 1 number 5 are on page **296**

The Product of Two Binomials (from pages 73)

Exercise 2:

1) Expand and simplify the following:

a) $(x+3)(x+2)$

b) $(x-3)(x+2)$

c) $(x-3)(x-2)$

d) $(a+2b)(a-3)$

e) $(2x+3)(x+1)$

f) $(7x+1)(2x-3)$

g) $(2x+5)(3x-7)$

h) $(7a-3b)(2a-b)$

i) $(3p+2q)(p-q)$

j) $(-2r+f)(r-f)$

k) $2(x+5)(x-3)$

l) $(x+2)(x+2)$

m) $(x-2)(x-2)$

n) $(x+5)(x+5)$

o) $(2x-1)(2x-1)$

p) $(x-1)(x+1)$

q) $(x-2)(x+2)$

r) $(2x-3)(2x+3)$

Solutions to Exercise 2 numbers 1a to f are on page **296** and numbers g to r are on page **297**

Square Binomials (from page 74)

2) Simplify the following:

a) $(x+3)^2$

b) $(x-3)^2$

c) $(x+7)^2$

d) $(x-1)^2$

e) $(x-12)^2$

f) $(x-9)^2$

g) $(x+11)^2$

h) $(2x-1)^2$

i) $\left(3x^3-2y^2\right)^2$

j) $\left(9n^2-m^8\right)^2$

k) $\left(2p-q^2\right)^2$

l) $\left(7a^7-b^5\right)^2$

m) $\left(\frac{x}{2}-1\right)^2$

n) $\left(\frac{x}{2}-3\right)^2$

o) $\left(\frac{y}{5}-1\right)^2$

Solutions to Exercise 2 number 2 are on page **297**

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Binomials which Differ in Sign (from page 75)

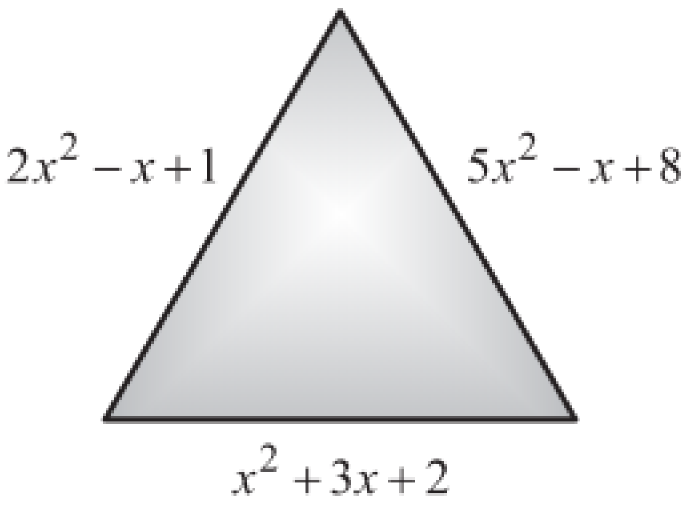
3) Expand and simplify the following:

a) $(x+3)(x-3)$
b) $(x-2)(x+2)$
c) $(x+7)(x-7)$
d) $(x-5)(x+5)$
e) $(x-11)(x+11)$
f) $(x+12)(x-12)$
g) $(p-2)(p+2)$
h) $(a-4)(a+4)$
i) $(p-2q)(p+2q)$
j) $(r-3t)(r+3t)$
k) $(x-7y)(x+7y)$
l) $(w-9f)(w+9f)$
m) $(2x-3y)(2x+3y)$
n) $(3ax-7by)(3ax+7by)$
o) $\left(\frac{2x}{3}-4y\right)\left(\frac{2x}{3}+4y\right)$
p) $\left(\frac{a}{3}-\frac{b}{2}\right)\left(\frac{a}{3}+\frac{b}{2}\right)$

Solutions to Exercise 2 numbers 3*a* to *n* are on page **297** and numbers *o and p* are on page **298**

Mixed Exercise:

1) The dimensions of a triangle are shown below. Determine the perimeter of the triangle. Your answer should be in terms of *x*.



Solutions to the Mixed Exercise number 1 are on page **298**

2) Answer the following questions:

a) Arrange $2^3x^2-2^6x^4-5+2^9x$ in descending powers of *x*.

b) Subtract $4x^2-6x+8$ from $-4x+2$.

Solutions to the Mixed Exercise number 2 are on page **298**

3) Expand and simplify the following:

a) $x(x-5)^2$
b) $(2a-b)(3a+5b)$
c) $-5x(2x-1)-2(x^2-3x+5)$
d) $\left(\frac{3x^2}{5}-7\right)\left(\frac{3x^2}{5}+7\right)$
e) $3n-n(n-2)-2(n-3)+n-5n$
f) $(2x-3)(3x+5)$
g) $3(3x-7)^2$
h) $(4x-2)(2x-3)$
i) $3\left(12x+\frac{2}{3}\right)^2$
j) $(2b-4)^2-(b+a)(b-a)-3$
k) $\left(\frac{3}{7}x-4\right)\left(\frac{3}{7}x+4\right)$
l) $(x-3y)(x-7y)-(x-8y)^2$
m) $x^2-(x-4)(x+4)$
n) $4x-5x\left(2x-\frac{1}{5}\right)$
o) $(2a-5b)(3a-4b+6b)$
p) $p(2p+1)(3p-2)-2p(p-7)^2$
q) $(x^{2a}+5)(x^{2a}-5)$

Solutions to the Mixed Exercise number 3*a* to *n* are on page **298** and *o* to *q* are on page **299**

4) Answer the questions below:

a) Use your calculator to determine the answer to $56874327^2-(56874329)(56874325)$.

b) Expand and simplify $x^2-(x+2)(x-2)$.

c) The answer your calculator gives in 4*a* above is incorrect. Use your answer in 4*b* to prove that the calculator's answer is incorrect and determine the correct answer.

Solutions to the Mixed Exercise number 4 are on page **299**

5) A swimming pool has a length of $x+12$ metres and breadth of $x-5$.

a) Determine an expression in terms of *x* for the area of the pool.

b) A grade 9 learner suggests that *x* could be equal to 4 metres. Is this possible? Justify your answer.

Solutions to the Mixed Exercise number 5 are on page **299**

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Chapter 8 – Algebraic Expressions (Solutions)

Exercise 1 Solutions:

1)

a) 2
b) 2
c) 1
d) 2
e) 1

Exercise 1 number 1 is on page **294**

2)

a) 3
b) – 4
c) 12
d) 2
e) $8(-1)^2-4(-1)+12$
$=8+4+12$
$=24$

Exercise 1 number 2 is on page **294**

3)

a) $8(x-3)-3(2x-3y)$
$=8x-24-6x+9y$
$=2x+9y-24$

b) $2a(a-2b)-3b(-a-5b)$
$=2a^2-4ab+3ab+15b^2$
$=2a^2-ab+15b^2$

c) $p(2-2q)-(p-5)(q)$
$=2p-2pq-pq+5q$
$=2p-3pq+5q$

d) $2\left(3x^2+8x-4\right)+x(x+3)$
$=6x^2+16x-8+x^2+3x$
$=7x^2+19x-8$

e) $(-2x)^2(x+3)-5+3(2x+1)$
$=4x^2(x+3)-5+6x+3$
$=4x^3+12x^2+6x-2$

Exercise 1 number 3 is on page **294**

4)

a) $2x^2-5x+1+x^2-5x+1$
$=3x^2-10x+2$

b) $-2x^2+x+1-\left(3x^2-2x+4\right)$
$=-2x^2+x+1-3x^2+2x-4$
$=-5x^2+3x-3$

c) $-5p^2-2q+4-\left(-2p^2-q+5\right)$
$=-5p^2-2q+4+2p^2+q-5$
$=-3p^2-q-1$

Exercise 1 number 4 is on page **294**

5)

a) 8 – 5
= 3

b) 5 – 3
= 2

c) $3x^2+2x-9-\left(-5x^2+2x-4\right)$
$=3x^2+2x-9+5x^2-2x+4$
$=8x^2+0x-5$
$=8x^2-5$

Exercise 1 number 5 is on page **294**

Exercise 2 Solutions:

1)

a) $(x+3)(x+2)$
$=x^2+2x+3x+6$
$=x^2+5x+6$

b) $(x-3)(x+2)$
$=x^2+2x-3x-6$
$=x^2-x-6$

c) $(x-3)(x-2)$
$=x^2-2x-3x+6$
$=x^2-5x+6$

d) $(a+2b)(a-3)$
$=a^2-3a+2ab-6b$

e) $(2x+3)(x+1)$
$=2x^2+2x+3x+3$
$=2x^2+5x+3$

f) $(7x+1)(2x-3)$
$=14x^2-21x+2x-3$
$=14x^2-19x-3$

Exercise 2 number 1 is on page **294** solutions are continued on the next page.

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g) $(2x+5)(3x-7)$
$=6x^2-14x+15x-35$
$=6x^2+x-35$

h) $(7a-3b)(2a-b)$
$=14a^2-7ab-6ab+3b^2$
$=14a^2-13ab+3b^2$

i) $(3p+2q)(p-q)$
$=3p^2-3pq+2pq-2q^2$
$=3p^2-pq-2q^2$

j) $(-2r+f)(r-f)$
$=-2r^2+2rf+fr-f^2$
$=-2r^2+3rf-f^2$

k) $2(x+5)(x-3)$
$=2(x^2-3x+5x-15)$
$=2x^2+4x-30$

l) $(x+2)(x+2)$
$=x^2+2x+2x+4$
$=x^2+4x+4$

m) $(x-2)(x-2)$
$=x^2-2x-2x+4$
$=x^2-4x+4$

n) $(x+5)(x+5)$
$=x^2+5x+5x+25$
$=x^2+10x+25$

o) $(2x-1)(2x-1)$
$=4x^2-2x-2x+1$
$=4x^2-4x+1$

p) $(x-1)(x+1)$
$=x^2+x-x-1$
$=x^2-1$

q) $(x-2)(x+2)$
$=x^2+2x-2x-4$
$=x^2-4$

r) $(2x-3)(2x+3)$
$=4x^2+6x-6x-9$
$=4x^2-9$

Exercise 2 number 1 is on page **294**

2)

a) $(x+3)^2$
$=x^2+6x+9$

b) $(x-3)^2$
$=x^2-6x+9$

c) $(x+7)^2$
$=x^2+14x+49$

d) $(x-1)^2$
$=x^2-2x+1$

e) $(x-12)^2$
$=x^2-24x+144$

f) $(x-9)^2$
$=x^2-18x+81$

g) $(x+11)^2$
$=x^2+22x+121$

h) $(2x-1)^2$
$=4x^2-4x+1$

i) $(3x^3-2y^2)^2$
$=9x^6-12x^3y^2+4y^4$

j) $(9n^2-m^8)^2$
$=81n^4-18n^2m^8+m^{16}$

k) $(2p-q^2)^2$
$=4p^2-4pq^2+q^4$

l) $(7a^7-b^5)^2$
$=49a^{14}-14a^7b^5+b^{10}$

m) $\left(\frac{x}{2}-1\right)^2$
$=\frac{x^2}{4}-x+1$

n) $\left(\frac{x}{2}-3\right)^2$
$=\frac{x^2}{4}-3x+9$

o) $\left(\frac{y}{5}-1\right)^2$
$=\frac{y^2}{25}-\frac{2y}{5}+1$

Exercise 2 number 2 is on page **294**

3)

a) $(x+3)(x-3)$
$=x^2-9$

b) $(x-2)(x+2)$
$=x^2-4$

c) $(x+7)(x-7)$
$=x^2-49$

d) $(x-5)(x+5)$
$=x^2-25$

e) $(x-11)(x+11)$
$=x^2-121$

f) $(x+12)(x-12)$
$=x^2-144$

g) $(p-2)(p+2)$
$=p^2-4$

h) $(a-4)(a+4)$
$=a^2-16$

i) $(p-2q)(p+2q)$
$=p^2-4q^2$

j) $(r-3t)(r+3t)$
$=r^2-9t^2$

k) $(x-7y)(x+7y)$
$=x^2-49y^2$

l) $(w-9f)(w+9f)$
$=w^2-81f^2$

m) $(2x-3y)(2x+3y)$
$=4x^2-9y^2$

n) $(3ax-7by)(3ax+7by)$
$=9a^2x^2-49b^2y^2$

Exercise 2 number 3 is on page **295** solutions are continued on the next page.

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o) $\left(\frac{2x}{3}-4y\right)\left(\frac{2x}{3}+4y\right)=\frac{4x^2}{9}-16y^2$

p) $\left(\frac{a}{3}-\frac{b}{2}\right)\left(\frac{a}{3}+\frac{b}{2}\right)=\frac{a^2}{9}-\frac{b^2}{4}$

Exercise 2 number 3 is on page **295**

Mixed Exercise Solutions:

1) $\text{Perimetre}=2x^2-x+1+x^2+3x+2+5x^2-x+8$

$=8x^2+x+11$

The Mixed Exercise number 1 is on page **295**

2)

a) $-2^6x^4+2^3x^2+2^9x-5$

b) $-4x+2-\left(4x^2-6x+8\right)$

$=-4x+2-4x^2+6x-8$

$=-4x^2+2x-6$

The Mixed Exercise number 2 is on page **295**

3)

a) $x(x-5)^2$

$=x\left(x^2-10x+25\right)$

$=x^3-10x^2+25x$

b) $(2a-b)(3a+5b)$

$=6a^2+10ab-3ab-5b^2$

$=6a^2+7ab-5b^2$

c) $-5x(2x-1)-2\left(x^2-3x+5\right)$

$=-10x^2+5x-2x^2+6x-10$

$=-12x^2+11x-10$

d) $\left(\frac{3x^2}{5}-7\right)\left(\frac{3x^2}{5}+7\right)$

$=\frac{9x^4}{25}-49$

e) $3n-n(n-2)-2(n-3)+n-5n$

$=3n-n^2+2n-2n+6+n-5n$

$=-n^2-n+6$

f) $(2x-3)(3x+5)$

$=6x^2+10x-9x-15$

$=6x^2+x-15$

g) $3(3x-7)^2$

$=3\left(9x^2-42x+49\right)$

$=27x^2-126x+147$

h) $(4x-2)(2x-3)$

$=8x^2-12x-4x+6$

$=8x^2-16x+6$

i) $3\left(12x+\frac{2}{3}\right)^2$

$=3\left(144x^2+16x+\frac{4}{9}\right)$

$=432x^2+48x+\frac{4}{3}$

j) $(2b-4)^2-(b+a)(b-a)-3$

$=4b^2-16b+16-\left(b^2-a^2\right)-3$

$=4b^2-16b+16-b^2+a^2-3$

$=3b^2-16b+a^2+13$

k) $\left(\frac{3}{7}x-4\right)\left(\frac{3}{7}x+4\right)$

$=\frac{9}{49}x^2-16$

l) $(x-3y)(x-7y)-(x-8y)^2$

$=x^2-7xy-3xy+21y^2-\left(x^2-16xy+64y^2\right)$

$=x^2-10xy+21y^2-x^2+16xy-64y^2$

$=6xy-43y^2$

m) $x^2-(x-4)(x+4)$

$=x^2-\left(x^2-16\right)$

$=x^2-x^2+16$

$=16$

n) $4x-5x\left(2x-\frac{1}{5}\right)$

$=4x-10x^2+x$

$=5x-10x^2$

The Mixed Exercise number 3 is on page **295**, solutions are continued on the next page.

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o) $(2a-5b)(3a-4b+6b)$

$=(2a-5b)(3a+2b)$

$=6a^2+4ab-15ab-10b^2$

$=6a^2-11ab-10b^2$

q) $\left(x^{2a}+5\right)\left(x^{2a}-5\right)$

$=\left(x^{2a}\right)^2-25$

$=x^{4a}-25$

p) $p(2p+1)(3p-2)-2p(p-7)^2$

$=p\left(6p^2-4p+3p-2\right)-2p\left(p^2-14p+49\right)$

$=6p^3-p^2-2p-2p^3+28p^2-98p$

$=4p^3+27p^2-102p$

The Mixed Exercise number 3 is on page **295**

4)

a) $56874327^2-(56874329)(56874325)=0 \rightarrow$ according to the calculator .

b) $x^2-(x+2)(x-2)$

$=x^2-\left(x^2-4\right)$

$=x^2-x^2+4$

$=4$

c) $56874327^2-(56874329)(56874325)$

$=56874327^2-(56874327+2)(56874327-2) \rightarrow x^2-(x+2)(x-2)$

$=4$

The Mixed Exercise number 4 is on page **295**

5) A swimming pool has a length of $x+12$ metres and breadth of $x-5$.

a) Area = length × breadth

$=(x+12)(x-5)$

$=x^2-5x+12x-60$

$=x^2+7x-60\,\text{m}^2$

b) It is not possible. If $x = 4$ is substituted into the breadth of the pool ($x - 5$), the breadth of the pool would be –1 metres, which is not possible as a length cannot be negative.

The Mixed Exercise number 5 is on page **295**

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Chapter 9 – Factorisation

Factorisation by taking out a HCF (from pages 79 - 81)

Exercise 1:

1) Factorise the following:

a) $3x+6$

b) $8x^2-4y^2+2x$

c) $8a^2-12ab+6a$

d) $10xy-8x^2y+4xy^2$

e) $15abc-20a^2bc+60ac$

f) $6mn-15m^2+24mn^2+18$

g) $27x^4-9x^3+6x^2$

h) $6a^2b^3-24ab^4+8a^3b^2$

i) $\frac{1}{2}x^2y+\frac{1}{4}xy$

j) $\frac{2a}{3}+\frac{ab}{3}$

Solutions to Exercise 1 number 1 are on page 303

2) Factorise the following:

a) $x(a-b)+y(a-b)$

b) $a(x+y)+b(y+x)$

c) $x^2(p-q)-y(p-q)$

d) $3x(2r+3q)+5y(3q+2r)$

e) $(a+b)z-(a+b)q$

f) $a(x-y)+3b(x-y)-5(x-y)$

g) $z^2(a+b)+y(b+a)-x(a+b)$

h) $x(3p+q)-2y(q+3p)+5z(q+3p)$

Solutions to Exercise 1 number 2 are on page 303

3) Factorise the following:

a) $x(a-b)+y(b-a)$

b) $3(x-y)+p(y-x)$

c) $x^2(2p-3q)-2x(3q-2p)$

d) $3a(a-5b)+6b(5b-a)$

e) $2(a+b)-x(b+a)+y(a+b)$

f) $2x(x-y)-8y(x-y)-4(y-x)$

g) $2xy(a-b)-x(b-a)$

h) $2a(2p-2q)-2ab(2p-2q)+6ac(2q-2p)$

Solutions to Exercise 1 number 3 are on page 303

Factorisation of the Difference of Two Squares (from pages 82 - 84)

Exercise 2:

1) Factorise the following:

a) x^2-16

b) x^2-144

c) $4a^2-25b^2$

d) $4p^2+q^2$

e) $4p^2-q^2$

f) x^2-4y^2

g) $9a^2-25b^2$

h) $64p^2-q^2$

i) $\frac{1}{x^2}-\frac{1}{y^2}$

j) $\frac{x^2}{9}-\frac{y^2}{36}$

k) $\frac{4r^2}{9f^2}-\frac{16q^2}{25h^2}$

l) $(x+5)^2-25$

m) $(x-10)^2-64$

n) $(x-25)^2-9$

o) $(x+2)^2-100$

p) $25(x-1)^2-121$

q) $(x-1)^2-(x+2)^2$

r) $(x+3)^2-(x-3)^2$

s) $4(x-1)^2-25(x+2)^2$

Solutions to Exercise 2 number 1a to f are on page 303 and numbers g to r are on page 304

2) Factorise the following:

a) $2x^2-8$

b) $50a^2-18$

c) $27a^2-48$

d) $16a^2-1$

e) $16a^4-1$

f) $2x^4-162$

g) a^8-81

h) $p^{16}-256$

i) $7p^{24}-7$

Solutions to Exercise 2 number 2 are on page 304

Factorisation of Trinomials (from pages 85 - 88)

Exercise 3:

1) Factorise the following:

a) x^2+5x+6

b) $x^2-11x+30$

c) $x^2+8x+15$

d) $x^2-15x+44$

e) $x^2+10x+24$

f) $x^2+10x+21$

g) $x^2-17x+60$

h) $x^2-17x+72$

i) $x^2+12x+35$

Solutions to Exercise 3 number 1 are on page 304

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2) Factorise the following:

a) x^2+5x-6

b) $x^2-4x-21$

c) $x^2-2x-15$

d) x^2-x-42

e) x^2+x-72

f) $x^2-5x-24$

g) $x^2+4x-77$

h) $x^2-6x-72$

i) $x^2-3x-28$

Solutions to Exercise 3 number 2 are on page **305**

3) Factorise the following:

a) $2x^3+8x^2+6x$

b) $3x^3-3x^2-36x$

c) $2a^3b+2a^2b-24ab$

d) $p^4+p^3-2p^2$

e) $5q^2-10q-400$

f) $2pt^2+24pt+72p$

g) $2p^4q-22p^3q-24p^2q$

h) $2a^2x^2-26ax^2+72x^2$

i) $8m^2n-96mn+280n$

Solutions to Exercise 3 number 3 are on page **305**

Simplifying Algebraic Expressions (from pages 89 - 91)

Exercise 4:

1) Simplify the following:

a) $\dfrac{xy+x}{xy}$

b) $\dfrac{8a+16}{8a}$

c) $\dfrac{2p^2+p}{p^2}$

d) $\dfrac{2x^2+2xy}{x+y}$

e) $\dfrac{y^2+8y}{y+8}$

f) $\dfrac{px+py}{2px+2py}$

g) $\dfrac{6p^2+6pq}{3p^2q+3pq^2}$

h) $\dfrac{6p^2+2pq}{12p^2q+4pq^2}$

i) $\dfrac{4a^2+4ab}{2a^3b+2a^2b^2}$

j) $\dfrac{16x^2y+8xy^2}{32xy+16y^2}$

k) $\dfrac{5xyz+50xy}{10x^2y^2z+100x^2y^2}$

l) $\dfrac{8xz+8yz}{zx+zy}$

Solutions to Exercise 4 number 1 are on page **305**

2) Simplify the following:

a) $\dfrac{2p^2-8p}{p^2-16}$

b) $\dfrac{x^2-5x}{x^2-7x+10}$

c) $\dfrac{8m^2+16m}{16}\times\dfrac{8}{m+2}$

d) $\dfrac{2a}{a+3}\div\dfrac{4a^2}{2a^2+6a}$

e) $\dfrac{2x}{x^3-5x^2}\div\dfrac{4x}{x^4-25x^2}$

f) $\dfrac{2x^3-4x^2-30x}{4x+20}\div\dfrac{x^2-9}{2x^2+4x-30}$

g) $\dfrac{x+3}{x-4}\times\dfrac{x+1}{x+2}\times\dfrac{x-4}{x+3}$

h) $\dfrac{x^2-4}{x^2+5x+6}\times\dfrac{x-5}{x+4}\div\dfrac{x^2-7x+10}{x^2+7x+12}$

i) $\dfrac{x^2-2x-15}{2x^3-4x^2-6x}\div\dfrac{x^2-3x-10}{2x^2-20x+42}\div\dfrac{x+3}{x^2+x}$

j) $\dfrac{x^2+x+1}{2xy^2-14xy+24x}\div\dfrac{x^4+x^3+x^2}{y^2-2y-8}\times\dfrac{x^3y-3x^3}{3}$

Solutions to Exercise 4 number 2 are on page **306**

Mixed Exercise:

1) Factorise the following expressions completely:

a) $-2ab-2ca$

b) $2x^2-2x-24$

c) $3x^2-27y^2$

d) $x^2y-5yx-6y$

e) $w^2(a-b)-9(a-b)$

f) $x^2(p-q)+4(q-p)$

Solutions to the Mixed Exercise number 1 are on page **307**

2) Answer the following:

a) Factorise a^2-b^2

b) Using your answer in *a* above, and without the use of a calculator determine the value of 2014^2-2013^2

Solutions to the Mixed Exercise number 2 are on page **307**

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3) The area of a square is x^2+6x+9, what is the length of the square? Give your answer in terms of x.

Solutions to the Mixed Exercise number 3 are on page **307**

4) One factor of $2x^7-18x^5$ is $2x^5$, what are the other 2 factors?

Solutions to the Mixed Exercise number 4 are on page **307**

5)

a) Complete the following sentences:
An even number multiplied by an odd number is always ______________
An odd number multiplied by an even number is always ______________

b) Factorise x^2+x

c) Thabiso claims that if x is a natural number, x^2+x will always be an even number. Is Thabiso correct? Explain your answer.

Solutions to the Mixed Exercise number 5 are on page **307**

6) Simplify the following:

a) $\dfrac{6q-7p}{14p-12q}$

b) $\dfrac{a^2-8a-20}{a+2}$

c) $\dfrac{p^2-6p+8}{3p-6}$

d) $\dfrac{4p^2q}{3p}\times\dfrac{5p}{q^3}\div\dfrac{60}{81pq^2}$

e) $\dfrac{a^2+2a}{a^2+a^3}\div\dfrac{4-a^2}{a^2-a-2}$

f) $\dfrac{4a^2-y^2}{a^2b^2}\div\dfrac{y-2a}{ab}$

g) $\dfrac{x^2-x-12}{x^2-2x-15}\div\dfrac{2xy+10y}{2x^2-50}$

h) $\dfrac{x^2-5x-6}{x^2-1}\div\dfrac{x(x-6)}{x-1}$

i) $\dfrac{x^3+5x^2+4x}{x^3+x^2}\div\dfrac{x^2+6x+8}{x^2+5x+6}+\dfrac{x^2+x+7}{2}$

Solutions to the Mixed Exercise number 6*a* and *b* are on page **307** and *c* to *i* are on page **308**

7) A number magic trick reads as follows:

1. **Pick a number**
2. **Multiply the number by 3**
3. **Add 9 to your total**
4. **Divide your total by 3**
5. **Finally, subtract the original number you picked from your total**

a) Perform the above magic trick and write down your answer.

b) Use your knowledge of algebra and factorisation to prove that no matter what number is picked the answer will always be 3. Hint: start by letting the number you pick be equal to x.

Solutions to the Mixed Exercise number 7 are on page **308**

8) Without using a calculator determine the value of:

$$\frac{10+20+30+40+...+900+1000}{1+2+3+4+...+90+100}$$

Solutions to the Mixed Exercise number 8 are on page **308**

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Chapter 9 – Factorisation (Solutions)

Exercise 1 Solutions:

1)

a) $3x+6$
$=3(x+2)$

b) $8x^2-4y^2+2x$
$=2\left(4x^2-2y^2+x\right)$

c) $8a^2-12ab+6a$
$=2a(4a-6b+3)$

d) $10xy-8x^2y+4xy^2$
$=2xy(5-4x+2y)$

e) $15abc-20a^2bc+60ac$
$=5ac(3b-4ab+12)$

f) $6mn-15m^2+24mn^2+18$
$=3\left(2mn-5m^2+8mn^2+6\right)$

g) $27x^4-9x^3+6x^2$
$=3x^2\left(9x^2-3x+2\right)$

h) $6a^2b^3-24ab^4+8a^3b^2$
$=2ab^2\left(3ab-12b^2+4a^2\right)$

i) $\frac{1}{2}x^2y+\frac{1}{4}xy$
$=\frac{1}{2}xy\left(x+\frac{1}{2}\right)$

j) $\frac{2a}{3}+\frac{ab}{3}$
$=\frac{a}{3}(2+b)$

Exercise 1 number 1 is on page **300**

2)

a) $x(a-b)+y(a-b)$
$=(a-b)(x+y)$

b) $a(x+y)+b(y+x)$
$=(x+y)(a+b)$

c) $x^2(p-q)-y(p-q)$
$=(p-q)\left(x^2-y\right)$

d) $3x(2r+3q)+5y(3q+2r)$
$=(2r+3q)(3x+5y)$

e) $(a+b)z-(a+b)q$
$=(a+b)(z-q)$

f) $a(x-y)+3b(x-y)-5(x-y)$
$=(x-y)(a+3b-5)$

g) $z^2(a+b)+y(b+a)-x(a+b)$
$=(a+b)\left(z^2+y-x\right)$

h) $x(3p+q)-2y(q+3p)+5z(q+3p)$
$=(3p+q)(x-2y+5z)$

Exercise 1 number 2 is on page **300**

3)

a) $x(a-b)+y(b-a)$
$=x(a-b)-y(a-b)$
$=(a-b)(x-y)$

b) $3(x-y)+p(y-x)$
$=3(x-y)-p(x-y)$
$=(x-y)(3-p)$

c) $x^2(2p-3q)-2x(3q-2p)$
$=x^2(2p-3q)+2x(2p-3q)$
$=x(2p-3q)(x+2)$

d) $3a(a-5b)+6b(5b-a)$
$=3a(a-5b)-6b(a-5b)$
$=3(a-2b)(a-5b)$

e) $2(a+b)-x(b+a)+y(a+b)$
$=(a+b)(2-x+y)$

f) $2x(x-y)-8y(x-y)-4(y-x)$
$=2x(x-y)-8y(x-y)+4(x-y)$
$=2(x-y)(x-4y+2)$

g) $2xy(a-b)-x(b-a)$
$=2xy(a-b)+x(a-b)$
$=x(2y+1)(a-b)$

h) $2a(2p-2q)-2ab(2p-2q)+6ac(2q-2p)$
$=2a(2p-2q)-2ab(2p-2q)-6ac(2p-2q)$
$=2a(2p-2q)(1-b-3c)$
$=4a(p-q)(1-b-3c)$

Exercise 1 number 3 is on page **300**

Exercise 2 Solutions:

1)

a) x^2-16
$=(x-4)(x+4)$

b) x^2-144
$=(x-12)(x+12)$

c) $4a^2-25b^2$
$=(2a-5b)(2a+5b)$

d) $4p^2+q^2$
$=4p^2+q^2\rightarrow$ can't factorise

e) $4p^2-q^2$
$=(2p-q)(2p+q)$

f) x^2-4y^2
$=(x-2y)(x+2y)$

Exercise 2 number 1 is on page **300** solutions are continued on the next page.

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g) $9a^2 - 25b^2$
$= (3a-5b)(3a+5b)$

h) $64p^2 - q^2$
$= (8p-q)(8p+q)$

i) $\frac{1}{x^2} - \frac{1}{y^2}$
$= \left(\frac{1}{x} - \frac{1}{y}\right)\left(\frac{1}{x} + \frac{1}{y}\right)$

j) $\frac{x^2}{9} - \frac{y^2}{36}$
$= \frac{1}{9}\left(x^2 - \frac{y^2}{4}\right)$
$= \frac{1}{9}\left(x - \frac{y}{2}\right)\left(x + \frac{y}{2}\right)$

k) $\frac{4r^2}{9f^2} - \frac{16q^2}{25h^2}$
$= \left(\frac{2r}{3f} - \frac{4q}{5h}\right)\left(\frac{2r}{3f} + \frac{4q}{5h}\right)$

l) $(x+5)^2 - 25$
$= [(x+5)-5][(x+5)+5]$
$= x(x+10)$

m) $(x-10)^2 - 64$
$= [(x-10)-8][(x-10)+8]$
$= (x-18)(x-2)$

n) $(x-25)^2 - 9$
$= [(x-25)-3][(x-25)+3]$
$= (x-28)(x-22)$

o) $(x+2)^2 - 100$
$= [(x+2)-10][(x+2)+10]$
$= (x-8)(x+12)$

p) $25(x-1)^2 - 121$
$= [5(x-1)-11][5(x-1)+11]$
$= (5x-5-11)(5x-5+11)$
$= (5x-16)(5x+6)$

q) $(x-1)^2 - (x+2)^2$
$= [(x-1)-(x+2)][(x-1)+(x+2)]$
$= (x-1-x-2)(x-1+x+2)$
$= -3(2x+1)$

r) $(x+3)^2 - (x-3)^2$
$= [(x+3)-(x-3)][(x+3)+(x-3)]$
$= (x+3-x+3)(x+3+x-3)$
$= 6(2x)$
$= 12x$

s) $4(x-1)^2 - 25(x+2)^2$
$= [2(x-1)-5(x+2)][2(x-1)+5(x+2)]$
$= (2x-2-5x-10)(2x-2+5x+10)$
$= (-3x-12)(7x+8)$

Exercise 2 number 1 is on page **300**

2)

a) $2x^2 - 8$
$= 2(x^2-4)$
$= 2(x-2)(x+2)$

b) $50a^2 - 18$
$= 2(25a^2 - 9)$
$= 2(5a-3)(5a+3)$

c) $27a^2 - 48$
$= 3(9a^2 - 16)$
$= 3(3a-4)(3a+4)$

d) $16a^2 - 1$
$= (4a-1)(4a+1)$

e) $16a^4 - 1$
$= (4a^2-1)(4a^2+1)$
$= (2a-1)(2a+1)(4a^2+1)$

f) $2x^4 - 162$
$= 2(x^4 - 81)$
$= 2(x^2-9)(x^2+9)$
$= 2(x-3)(x+3)(x^2+9)$

g) $a^8 - 81$
$= (a^4-9)(a^4+9)$
$= (a^2-3)(a^2+3)(a^4+9)$

h) $p^{16} - 256$
$= (p^8-16)(p^8+16)$
$= (p^4-4)(p^4+4)(p^8+16)$
$= (p^2-2)(p^2+2)(p^4+4)(p^8+16)$

i) $7p^{24} - 7$
$= 7(p^{12}-1)(p^{12}+1)$
$= 7(p^6-1)(p^6+1)(p^{12}+1)$
$= 7(p^3-1)(p^3+1)(p^6+1)(p^{12}+1)$

Exercise 2 number 2 is on page **300**

<u>Exercise 3 Solutions</u>:

1)

a) $x^2 + 5x + 6$
$= (x+3)(x+2)$

b) $x^2 - 11x + 30$
$= (x-6)(x-5)$

c) $x^2 + 8x + 15$
$= (x+5)(x+3)$

d) $x^2 - 15x + 44$
$= (x-11)(x-4)$

e) $x^2 + 10x + 24$
$= (x+6)(x+4)$

f) $x^2 + 10x + 21$
$= (x+7)(x+3)$

g) $x^2 - 17x + 60$
$= (x-12)(x-5)$

h) $x^2 - 17x + 72$
$= (x-9)(x-8)$

i) $x^2 + 12x + 35$
$= (x+5)(x+7)$

Exercise 3 number 1 is on page **300**

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2)

a) x^2+5x-6
$=(x+6)(x-1)$

b) $x^2-4x-21$
$=(x-7)(x+3)$

c) $x^2-2x-15$
$=(x-5)(x+3)$

d) x^2-x-42
$=(x+6)(x-7)$

e) x^2+x-72
$=(x-8)(x+9)$

f) $x^2-5x-24$
$=(x-8)(x+3)$

g) $x^2+4x-77$
$=(x-7)(x+11)$

h) $x^2-6x-72$
$=(x-12)(x+6)$

i) $x^2-3x-28$
$=(x-7)(x+4)$

Exercise 3 number 2 is on page **301**

3)

a) $2x^3+8x^2+6x$
$=2x\left(x^2+4x+3\right)$
$=2x(x+3)(x+1)$

b) $3x^3-3x^2-36x$
$=3x\left(x^2-x-12\right)$
$=3x(x-4)(x+3)$

c) $2a^3b+2a^2b-24ab$
$=2ab\left(a^2+a-12\right)$
$=2ab(a+4)(a-3)$

d) $p^4+p^3-2p^2$
$=p^2\left(p^2+p-2\right)$
$=p^2(p+2)(p-1)$

e) $5q^2-10q-400$
$=5\left(q^2-2q-80\right)$
$=5(q+8)(q-10)$

f) $2pt^2+24pt+72p$
$=2p\left(t^2+12t+36\right)$
$=2p(t+6)(t+6)$

g) $2p^4q-22p^3q-24p^2q$
$=2p^2q\left(p^2-11p-12\right)$
$=2p^2q(p-12)(p+1)$

h) $2a^2x^2-26ax^2+72x^2$
$=2x^2\left(a^2-13a+36\right)$
$=2x^2(a-9)(a-4)$

i) $8m^2n-96mn+280n$
$=8n\left(m^2-12m+35\right)$
$=8n(m-7)(m-5)$

Exercise 3 number 3 is on page **301**

<u>Exercise 4 Solutions</u>:

1)

a) $\dfrac{xy+x}{xy}$
$=\dfrac{\cancel{x}(y+1)}{\cancel{x}y}$
$=\dfrac{y+1}{y}$

b) $\dfrac{8a+16}{8a}$
$=\dfrac{\cancel{8}(a+2)}{\cancel{8}a}$
$=\dfrac{a+2}{a}$

c) $\dfrac{2p^2+p}{p^2}$
$=\dfrac{\cancel{p}(2p+1)}{p^{\cancel{2}1}}$
$=\dfrac{2p+1}{p}$

d) $\dfrac{2x^2+2xy}{x+y}$
$=\dfrac{2x\cancel{(x+y)}}{\cancel{x+y}}$
$=2x$

e) $\dfrac{y^2+8y}{y+8}$
$=\dfrac{y\cancel{(y+8)}}{\cancel{y+8}}$
$=y$

f) $\dfrac{px+py}{2px+2py}$
$=\dfrac{\cancel{p}\cancel{(x+y)}}{2\cancel{p}\cancel{(x+y)}}$
$=\dfrac{1}{2}$

g) $\dfrac{6p^2+6pq}{3p^2q+3pq^2}$
$=\dfrac{\cancel{6}^2\cancel{p}\cancel{(p+q)}}{\cancel{3}\cancel{p}q\cancel{(p+q)}}$
$=\dfrac{2}{q}$

h) $\dfrac{6p^2+2pq}{12p^2q+4pq^2}$
$=\dfrac{\cancel{2}\cancel{p}\cancel{(3p+q)}}{\cancel{4}^2\cancel{p}q\cancel{(3p+q)}}$
$=\dfrac{1}{2q}$

i) $\dfrac{4a^2+4ab}{2a^3b+2a^2b^2}$
$=\dfrac{\cancel{4}^2\cancel{a}\cancel{(a+b)}}{\cancel{2}a^{\cancel{2}1}b\cancel{(a+b)}}$
$=\dfrac{2}{ab}$

j) $\dfrac{16x^2y+8xy^2}{32xy+16y^2}$
$=\dfrac{\cancel{8}x\cancel{y}\cancel{(2x+y)}}{\cancel{16}^2\cancel{y}\cancel{(2x+y)}}$
$=\dfrac{x}{2}$

k) $\dfrac{5xyz+50xy}{10x^2y^2z+100x^2y^2}$
$=\dfrac{\cancel{5}\cancel{xy}\cancel{(z+10)}}{\cancel{10}^2x^{\cancel{2}1}y^{\cancel{2}1}\cancel{(z+10)}}$
$=\dfrac{1}{2xy}$

l) $\dfrac{8xz+8yz}{zx+zy}$
$=\dfrac{8\cancel{z}\cancel{(x+y)}}{\cancel{z}\cancel{(x+y)}}$
$=8$

Exercise 4 number 1 is on page **301**

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2)

a) $\dfrac{2p^2-8p}{p^2-16}$

$= \dfrac{2p\cancel{(p-4)}}{\cancel{(p-4)}(p+4)}$

$= \dfrac{2p}{p+4}$

b) $\dfrac{x^2-5x}{x^2-7x+10}$

$= \dfrac{x\cancel{(x-5)}}{\cancel{(x-5)}(x-2)}$

$= \dfrac{x}{x-2}$

c) $\dfrac{8m^2+16m}{16} \times \dfrac{8}{m+2}$

$= \dfrac{\cancel{8}m\cancel{(m+2)}}{\cancel{16}^{\cancel{2}}} \times \dfrac{\cancel{8}^4}{\cancel{m+2}}$

$= 4m$

d) $\dfrac{2a}{a+3} \div \dfrac{4a^2}{2a^2+6a}$

$= \dfrac{\cancel{2}\cancel{a}}{\cancel{a+3}} \times \dfrac{\cancel{2}\cancel{a}\cancel{(a+3)}}{\cancel{4}^{\cancel{2}}\cancel{a}^{\cancel{2}}}$

$= 1$

e) $\dfrac{2x}{x^3-5x^2} \div \dfrac{4x}{x^4-25x^2}$

$= \dfrac{\cancel{2}\cancel{x}}{\cancel{x^2}(x-5)} \times \dfrac{\cancel{x^2}(x^2-25)}{\cancel{4}^2\cancel{x}}$

$= \dfrac{1}{\cancel{(x-5)}} \times \dfrac{\cancel{(x-5)}(x+5)}{2}$

$= \dfrac{x+5}{2}$

f) $\dfrac{2x^3-4x^2-30x}{4x+20} \div \dfrac{x^2-9}{2x^2+4x-30}$

$= \dfrac{\cancel{2}x\left(x^2-2x-15\right)}{\cancel{4}^{\cancel{2}}(x+5)} \times \dfrac{\cancel{2}\left(x^2+2x-15\right)}{(x-3)(x+3)}$

$= \dfrac{x\cancel{(x+3)}(x-5)}{\cancel{x+5}} \times \dfrac{\cancel{(x+5)}\cancel{(x-3)}}{\cancel{(x-3)}\cancel{(x+3)}}$

$= x^2-5x$

g) $\dfrac{x+3}{x-4} \times \dfrac{x+1}{x+2} \times \dfrac{x-4}{x+3}$

$= \dfrac{\cancel{x+3}}{\cancel{x-4}} \times \dfrac{x+1}{x+2} \times \dfrac{\cancel{x-4}}{\cancel{x+3}}$

$= \dfrac{x+1}{x+2}$

h) $\dfrac{x^2-4}{x^2+5x+6} \times \dfrac{x-5}{x+4} \div \dfrac{x^2-7x+10}{x^2+7x+12}$

$= \dfrac{(x-2)(x+2)}{(x+3)(x+2)} \times \dfrac{x-5}{x+4} \times \dfrac{x^2+7x+12}{x^2-7x+10}$

$= \dfrac{\cancel{(x-2)}\cancel{(x+2)}}{\cancel{(x+3)}\cancel{(x+2)}} \times \dfrac{\cancel{x-5}}{\cancel{x+4}} \times \dfrac{\cancel{(x+3)}\cancel{(x+4)}}{\cancel{(x-5)}\cancel{(x-2)}}$

$= 1$

i) $\dfrac{x^2-2x-15}{2x^3-4x^2-6x} \div \dfrac{x^2-3x-10}{2x^2-20x+42} \div \dfrac{x+3}{x^2+x}$

$= \dfrac{x^2-2x-15}{2x\left(x^2-2x-3\right)} \times \dfrac{2\left(x^2-10x+21\right)}{x^2-3x-10} \times \dfrac{x(x+1)}{x+3}$

$= \dfrac{\cancel{(x-5)}\cancel{(x+3)}}{\cancel{2}\cancel{x}\cancel{(x-3)}\cancel{(x+1)}} \times \dfrac{\cancel{2}(x-7)\cancel{(x-3)}}{\cancel{(x-5)}(x+2)} \times \dfrac{\cancel{x}\cancel{(x+1)}}{\cancel{x+3}}$

$= \dfrac{x-7}{x+2}$

j) $\dfrac{x^2+x+1}{2xy^2-14xy+24x} \div \dfrac{x^4+x^3+x^2}{y^2-2y-8} \times \dfrac{x^3y-3x^3}{3}$

$= \dfrac{\cancel{x^2+x+1}}{2\cancel{x}\left(y^2-7y+12\right)} \times \dfrac{y^2-2y-8}{\cancel{x^2}\cancel{\left(x^2+x+1\right)}} \times \dfrac{\cancel{x^3}(y-3)}{3}$

$= \dfrac{1}{2\cancel{(y-4)}\cancel{(y-3)}} \times \dfrac{\cancel{(y-4)}(y+2)}{1} \times \dfrac{\cancel{y-3}}{3}$

$= \dfrac{y+2}{6}$

Exercise 4 number 2 is on page **301**

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Mixed Exercise Solutions:

1)

a) $-2ab-2ca$

$=2a(-b-c)\rightarrow -2a(b+c)$ is also correct

b) $2x^2-2x-24$

$=2\left(x^2-x-12\right)$

$=2(x-4)(x+3)$

c) $3x^2-27y^2$

$=3\left(x^2-9y^2\right)$

$=3(x-3y)(x+3y)$

d) $x^2y-5yx-6y$

$=y\left(x^2-5x-6\right)$

$=y(x-6)(x+1)$

e) $w^2(a-b)-9(a-b)$

$=(a-b)\left(w^2-9\right)$

$=(a-b)(w-3)(w+3)$

f) $x^2(p-q)+4(q-p)$

$=x^2(p-q)-4(p-q)$

$=(p-q)\left(x^2-4\right)$

$=(p-q)(x-2)(x+2)$

The Mixed Exercise number 1 is on page **301**

2)

a) $a^2-b^2=(a-b)(a+b)$

b) 2014^2-2013^2

$=(2014-2013)(2014+2013)$

$=(1)(4027)=4027$

The Mixed Exercise number 2 is on page **301**

3) $x^2+6x+9=(x+3)(x+3)$

Therefore, the length of the square is $x+3$.

The Mixed Exercise number 3 is on page **302**

4) $2x^7-18x^5$

$=2x^5\left(x^2-9\right)$

$=2x^5(x-3)(x+3)$

$\therefore$ The other two factors are $x+3$ and $x-3$.

The Mixed Exercise number 4 is on page **302**

5)

a) An even number multiplied by an odd number is always **even.**
An odd number multiplied by an even number is always **even.**

b) x^2+x

$=x(x+1)$

c) If x is an even number, then $x+1$ is an odd number and an even number times an odd number is even.
If x is an odd number, then $x+1$ is an even number and an odd number times an even number is even.
Therefore, Thabiso is correct.

The Mixed Exercise number 5 is on page **302**

6)

a) $\dfrac{6p-7q}{14p-12q}$

$=\dfrac{\cancel{6q-7p}}{-2\cancel{(6q-7p)}}$

$=-\dfrac{1}{2}$

b) $\dfrac{a^2-8a-20}{a+2}$

$=\dfrac{(a-10)\cancel{(a+2)}}{\cancel{a+2}}$

$=a-10$

The Mixed Exercise number 6 is on page **302** (solutions are continued on the next page)

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c) $\dfrac{p^2-6p+8}{3p-6}$

$=\dfrac{(p-4)\cancel{(p-2)}}{3\cancel{(p-2)}}$

$=\dfrac{p-4}{3}$

d) $\dfrac{4p^2q}{3p}\times\dfrac{5p}{q^3}\div\dfrac{60}{81pq^2}$

$=\dfrac{\cancel{4}p^2\cancel{q}}{\cancel{3}\cancel{p}}\times\dfrac{\cancel{5}p}{\cancel{q^3}}\times\dfrac{\cancel{81}^{9}\cancel{p}\cancel{q^2}}{\cancel{60}\cancel{12}\cancel{3}}$

$=9p^3$

e) $\dfrac{a^2+2a}{a^2+a^3}\div\dfrac{4-a^2}{a^2-a-2}$

$=\dfrac{\cancel{a}\cancel{(a+2)}}{a^{\cancel{2}}\cancel{(1+a)}}\times\dfrac{(a-2)\cancel{(a+1)}}{(2-a)\cancel{(2+a)}}$

$=\dfrac{\cancel{a-2}}{-a\cancel{(a-2)}}$

$=-\dfrac{1}{a}$

f) $\dfrac{4a^2-y^2}{a^2b^2}\div\dfrac{y-2a}{ab}$

$=\dfrac{(2a-y)(2a+y)}{a^{\cancel{2}}b^{\cancel{2}}}\times\dfrac{\cancel{ab}}{y-2a}$

$=\dfrac{\cancel{(2a-y)}(2a+y)}{ab}\times\dfrac{1}{-\cancel{(2a-y)}}$

$=-\dfrac{2a+y}{ab}=\dfrac{-2a-y}{ab}$

g) $\dfrac{x^2-x-12}{x^2-2x-15}\div\dfrac{2xy+10y}{2x^2-50}$

$=\dfrac{(x-4)\cancel{(x+3)}}{(x-5)\cancel{(x+3)}}\times\dfrac{\cancel{2}(x^2-25)}{\cancel{2}y(x+5)}$

$=\dfrac{x-4}{\cancel{x-5}}\times\dfrac{\cancel{(x-5)}\cancel{(x+5)}}{y\cancel{(x+5)}}$

$=\dfrac{x-4}{y}$

h) $\dfrac{x^2-5x-6}{x^2-1}\div\dfrac{x(x-6)}{x-1}$

$=\dfrac{\cancel{(x-6)}\cancel{(x+1)}}{\cancel{(x-1)}\cancel{(x+1)}}\times\dfrac{\cancel{x-1}}{x\cancel{(x-6)}}$

$=\dfrac{1}{x}$

i) $\dfrac{x^3+5x^2+4x}{x^3+x^2}\div\dfrac{x^2+6x+8}{x^2+5x+6}+\dfrac{x^2+x+7}{2}$

$=\dfrac{\cancel{x}(x^2+5x+4)}{x^{\cancel{2}}(x+1)}\times\dfrac{(x+3)\cancel{(x+2)}}{(x+4)\cancel{(x+2)}}+\dfrac{x^2+x+7}{2}$

$=\dfrac{\cancel{(x+4)}\cancel{(x+1)}}{x\cancel{(x+1)}}\times\dfrac{(x+3)}{\cancel{(x+4)}}+\dfrac{x^2+x+7}{2}$

$=\dfrac{x+3}{x}+\dfrac{x^2+x+7}{2}\rightarrow \text{LCD}=2x$

$=\dfrac{2(x+3)+x(x^2+x+7)}{2x}$

$=\dfrac{2x+6+x^3+x^2+7x}{2x}$

$=\dfrac{x^3+x^2+9x+6}{2x}$

The Mixed Exercise number 6 is on page **302**

7)

a) 3

b) Step 1: let the number you pick equal x

Step 2: $3x\rightarrow$ mulitply the number by 3

Step 3: $3x+9\rightarrow$ add 9

Step 4: $\dfrac{3x+9}{3}\rightarrow$ divide by 3

Step 5: $\dfrac{3x+9}{3}-x\rightarrow$ subtract the original number (x)

Now simplify :

$\dfrac{3x+9}{3}-x=\dfrac{\cancel{3}(x+3)}{\cancel{3}}-x=x+3-x=3$

The Mixed Exercise number 7 is on page **302**

8) $\dfrac{10+20+30+40+\ldots+900+1000}{1+2+3+4+\ldots+90+100}=\dfrac{10\cancel{(1+2+3+4+\ldots+90+100)}}{\cancel{(1+2+3+4+\ldots+90+100)}}$

$=10$

The Mixed Exercise number 8 is on page **302**

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Chapter 10 – Equations

Grade 8 Revision (from pages 93 and 94)

Exercise 1:

1) Solve the following equations:

a) $x-12=3x$

b) $5x-3=2x+12$

c) $2(3x-8)+7=4(x-2)+1$

d) $3(x+8)=12$

e) $4a+6(a-2)=8$

f) $4(4r+18)+6(r-4)=6r$

g) $3(y-5)+4(y+1)=5(2y-1)$

h) $5(2p)-(3p+1)=-(3p+1)(2)$

i) $3(2d+4)-7(d+1)=3$

j) $2(3y+5)+xy=y(x+5)$

k) $2x(x+3)-5(x+4)=2x^2+5x-4$

Solutions to Exercise 1 number 1 are on page **313**

Solving Equations with Fractions (from pages 95 - 97)

Exercise 2:

1) Solve the following equations:

a) $\frac{5x}{4}-\frac{10x}{3}=15$

b) $\frac{8x}{3}-2x=-\frac{2}{3}$

c) $9a-\frac{3a}{4}=33$

d) $\frac{5x}{3}+3=-\frac{2x}{5}$

e) $\frac{b}{4}-\frac{2b}{3}+5=0$

f) $\frac{15r}{2}+4\frac{1}{2}=\frac{12r}{4}$

g) $\frac{15x}{2}-\frac{9x}{4}-1\frac{1}{2}=9$

h) $\frac{x}{3}-2(x-1)=\frac{5x}{2}-3$

i) $7q+\frac{21}{4}=7+\frac{7q}{2}$

j) $\frac{11x}{2}-\frac{3x}{5}=3-\frac{7x}{10}$

Solutions to Exercise 2 number 1 are on page **314**

2) Solve the following equations:

a) $\frac{x+2}{2}-\frac{x-3}{3}=x-\frac{1}{2}$

b) $\frac{q+6}{5}+\frac{2q+1}{10}=3-\frac{1}{2}$

c) $\frac{a+3}{4}-\frac{a}{2}=\frac{a+2}{8}-1$

d) $\frac{x+1}{3}-\frac{5x-1}{2}=-\frac{2x-4}{2}$

e) $\frac{2q+1}{3}-\frac{q+2}{8}=\frac{3q+1}{4}$

f) $\frac{2x}{5}+\frac{2x-18}{3}+\frac{x}{3}=3x-2$

g) $\frac{2x+5}{2}-\frac{x+1}{3}=\frac{1}{3}-\frac{x+5}{12}$

h) $\frac{7x+3}{2}-\frac{x+3}{7}=\frac{5x+1}{14}$

Solutions to Exercise 2 number 2*a* to *d* are on page **314** and number 2*e* to 2*h* are on page **315**

3) Solve the following equations:

a) $7+\frac{5}{x}=\frac{5(x+3)}{x}$

b) $\frac{3(x+2)}{x}+\frac{5}{2}=3+\frac{6}{x}$

c) $\frac{3(x-2)}{x}-\frac{5}{2}=\frac{2}{x}+\frac{1}{6}$

d) $\frac{2}{5}-\frac{3(x+2)}{3x}-1=4-\frac{30}{15x}$

Solutions to Exercise 2 number 3 are on page **315**

Quadratic Equations (from pages 98 - 101)

Exercise 3:

1) Solve for the unknown variable(s) in each of the equations below:

a) $(x+3)(x-5)=0$

b) $(x+4)(x-5)=0$

c) $(a+7)(a-1)=0$

d) $(2x+1)(3x-4)=0$

e) $(5p+4)(2x+11)=0$

f) $(9x-5)(7y-3)(2x+5)=0$

g) $2^{(x+3)(x-5)}=1$

Solutions to Exercise 3 number 1 are on page **315**

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2) Solve the following equations:

a) $x^2 + 5x = 0$
b) $a^2 = 6a$
c) $p^2 = -2p$
d) $2x^2 - 4x = 0$
e) $x^2 - 3x - 10 = 0$
f) $m^2 + 9m + 14 = 0$
g) $x^2 - 11x + 10 = 0$
h) $r^2 + 2r = 8$
i) $2w^2 - 6w - 36 = 0$
j) $2x^2 - 18x = 44$
k) $3x^2 = 6x + 72$
l) $-72y = -3y^2 + 75$

Solutions to Exercise 3 number 2 are on page **316**

3) Solve the following equations:

a) $(x-4)(x-6) = 24$
b) $2(x-2)^2 = 32$
c) $(x-3)(x-4) = 72$
d) $(x-2)(x+1) = 18$
e) $3(x-1)^2 - 75 = 0$
f) $(x-3)(x+8) + 30 = 0$

Solutions to Exercise 3 number 3 are on page **316**

Mathematical Modelling (Word Problems) (from pages 102 - 104)

Exercise 4:

1) Solve the following problems:

a) Three times a certain number decreased by 5 is equal to 31. What is the number?
b) Fourteen times a certain number decreased by 8 is equal to 20. What is the number?
c) If you quadruple a certain number and add 5, the answer is the same as when you double the number and add 5. What is the number?
d) The sum of three consecutive even natural numbers is 60. What are the numbers?
e) The sum of three consecutive odd natural numbers is 27. What are the numbers?
f) Joseph is 6 years older than his sister Natasha. Their combined age is the same as their father's age. If their father is 50 years old, how old are Joseph and Natasha?
g) Harry is 7 times as old as his son. The product of their ages is 175. How old is Harry and his son?
h) A father is 30 years older than his son. Three years ago he was 3 times as old as his son. How old are both of them now?

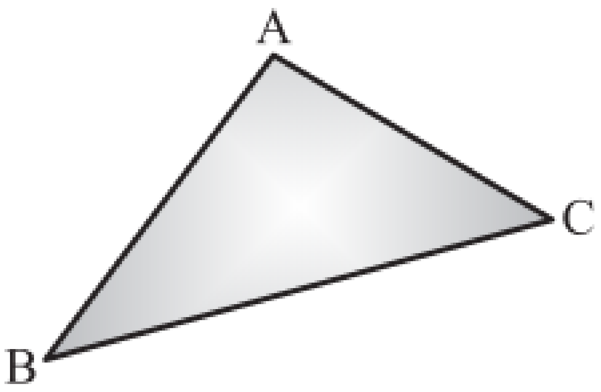
Solutions to Exercise 4 number 1 are on page **317**

2) A school tuckshop has x lollipops to sell. On a certain day, they sell all but 5 of their lollipops.

a) Write down an expression in terms of x for the number of lollipops the tuckshop sold.
b) If each lollipop was sold for R2, and the school received a R190 for the sale of the lollipops, determine the value of x, and the number of lollipops that were sold.

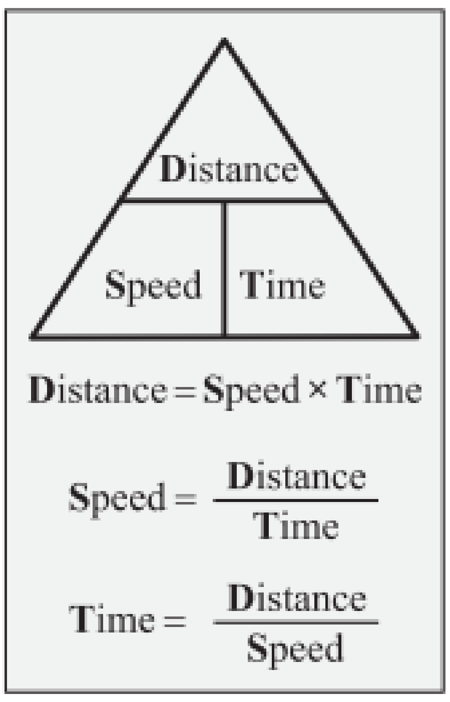
Solutions to Exercise 4 number 2 are on page **317**

3) In triangle ABC alongside, AB is x cm long. Side BC is 3 cm longer than AB and AC is 1 cm shorter than AB. How long is side AB if the perimeter of the triangle is 14cm?



Solutions to Exercise 4 number 3 are on page **317**

4) An aeroplane travels from Johannesburg to Cape Town in two and a half hours. On its return flight there is a tail wind and it only takes the plane 2 hours. Due to the tailwind the plane flies 140 km/h faster. If the distance between Cape Town and Johannesburg is x km:



a) Write down an expression for the speed of the plane from Johannesburg to Cape Town.
b) Write down an expression for the speed of the plane from Cape Town to Johannesburg.
c) Use your answers above to determine how far Johannesburg is from Cape Town.
d) At what speed did the plane fly from Johannesburg to Cape Town?

Solutions to Exercise 4 number 4 are on page **318**

5) Solve the following problems:

a) The product of two positive consecutive numbers is 132. What are the numbers?
b) The product of two negative even consecutive numbers is 48. What are the numbers?
c) The product of Lauren and Nawaz's ages is 54. If Nawaz is 3 years older than Lauren, Determine Harry's age.

Solutions to Exercise 4 number 5 are on page **318**

6) Zara's Bedroom is a rectangle with an area of $15m^2$. The width of her bedroom is 2 metres more than the length. Determine the dimensions of her bedroom.

Solutions to Exercise 4 number 6 are on page **319**

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Mixed Exercise:

1) Solve the following equations:

a) $3x+5=8x-4$

b) $\frac{x-3}{3}-\frac{2x+1}{2}=4x-3$

c) $\frac{x}{12}-1-\frac{x+2}{3}=-\frac{3x}{4}$

d) $\frac{(2a+3)(b-5)}{1250860}=0$

e) $(x+3)^2=x^2+9$

f) $(2y+3)(2y-3)=4y^2+9$

g) $2(x+2)=3(3x-4)$

h) $4^{y+1}=8$

i) $\frac{3-x}{4}=-5$

j) $4\times4^x=65\,536$

k) $\frac{x+1}{2}-\frac{2x}{3}=1$

l) $3\times2^x=24$

m) $\frac{1-x}{3x}+\frac{1}{9}=\frac{x+3}{9x}$

Solutions to the Mixed Exercise number 1 are on page **319**

2) Solve the following equations:

a) $x^2=4x^2$

b) $x^3-4x=0$

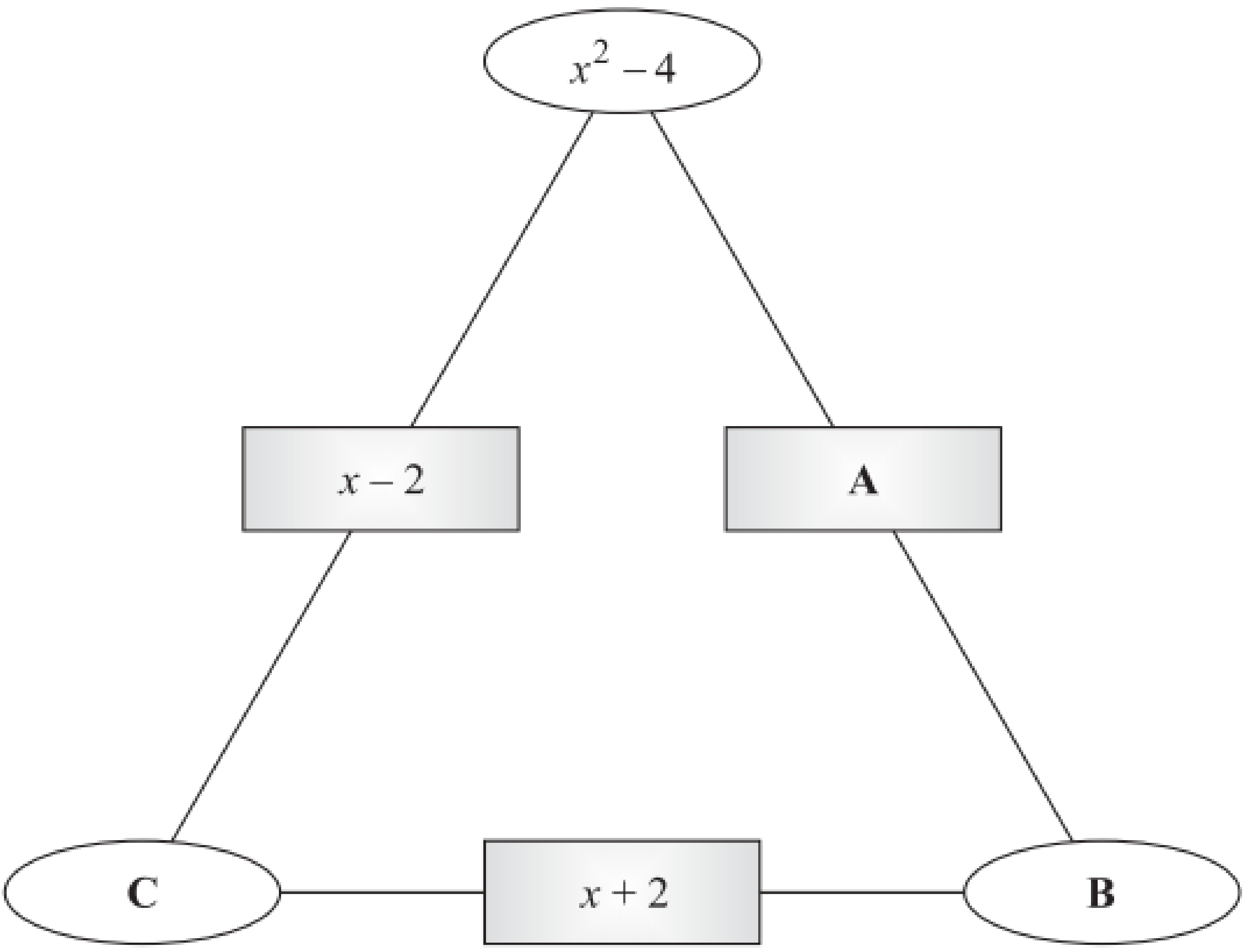
c) $(x-1)(x+8)=-14$

d) $2(x+2)=3(3x-4)$

e) $(x-3)^2-2(x+1)=(x-1)(x+4)$

Solutions to the Mixed Exercise number 2 are on page **320**

3) The numbers in the oval circles below are obtained by multiplying the shaded squares along the two lines that meet at the oval. In other words, x^2-4 is obtained by multiplying $x-2$ with A. Determine the expressions A, B and C.



Solutions to the Mixed Exercise number 3 are on page **320**

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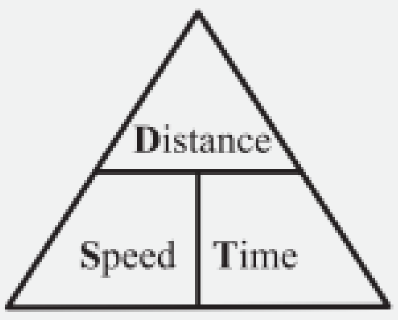
4) Sally walks to the school bus stop at a speed of 5 km/h. As soon as she arrives at the bus stop the bus leaves for school travelling at an average speed of 30 km/h in traffic. Sally lives 15km from her school.



Distance = Speed × Time

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

a) Complete the table below:

	Speed (km/h)	Distance (km)	Time (h)
Walking	5	x	
Driving	30		

b) It takes Sally 90 minutes to get to school. Convert this time into hours.

c) Using the table above determine the distance which Sally walks to school.

Solutions to the Mixed Exercise number 4 are on page **320**

5) A Mother is 46 years old and her daughter is 19 years old. How many years will it take for the mother to be twice as old as her daughter?

Solutions to the Mixed Exercise number 5 are on page **320**

6) If $y = 2x + 5$ determine the value of:

a) y if $x = -3$.

b) x if $y = -8$.

c) x if $y = 12$.

d) y if $x = 20$

Solutions to the Mixed Exercise number 6 are on page **321**

7) Given the equation $\dfrac{(x+2)(x+3)}{x+2} = 1$:

a) Write down a restriction on the value of x.

b) Hence, solve the equation.

Solutions to the Mixed Exercise number 7 are on page **321**

8) Given that $x^2 - y^2 = 15$ and that $x - y = 5$, determine the value of $x + y$.

Solutions to the Mixed Exercise number 8 are on page **321**

9) A soccer stadium is to host a concert forfrom an international pop star. The concert is attended by 60 000 people. Adult tickets are sold at a cost of R550 per ticket and children's tickets are sold at a cost of R350 per ticket.

a) If x children attended the concert, write down an expression for the number of adults that attended in terms of x.

b) The total cost of all the tickets sold was R25 000 000. How many adult tickets were sold?

Solutions to the Mixed Exercise number 9 are on page **321**

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Chapter 10 – Equations (Solutions)

Exercise 1 Solutions:

1)

a) $x-12=3x$
$\therefore -2x=12$
$\therefore x=\dfrac{12}{-2}$
$\therefore x=-6$

b) $5x-3=2x+12$
$\therefore 3x=15$
$\therefore x=\dfrac{15}{3}$
$\therefore x=5$

c) $2(3x-8)+7=4(x-2)+1$
$\therefore 6x-16+7=4x-8+1$
$\therefore 2x=2$
$\therefore x=\dfrac{2}{2}$
$\therefore x=1$

d) $3(x+8)=12$
$\therefore 3x+24=12$
$\therefore 3x=-12$
$\therefore x=\dfrac{-12}{3}$
$\therefore x=-4$

e) $4a+6(a-2)=8$
$\therefore 4a+6a-12=8$
$\therefore 10a=20$
$\therefore a=\dfrac{20}{10}$
$\therefore a=2$

f) $4(4r+18)+6(r-4)=6r$
$\therefore 16r+72+6r-24=6r$
$\therefore 16r=-48$
$\therefore r=\dfrac{-48}{16}$
$\therefore r=-3$

g) $3(y-5)+4(y+1)=5(2y-1)$
$\therefore 3y-15+4y+4=10y-5$
$\therefore -3y=6$
$\therefore y=\dfrac{6}{-3}$
$\therefore y=-2$

h) $5(2p)-(3p+1)=-(3p+1)(2)$
$\therefore 10p-3p-1=-6p-2$
$\therefore 13p=-1$
$\therefore p=-\dfrac{1}{13}$

i) $3(2d+4)-7(d+1)=3$
$\therefore 6d+12-7d-7=3$
$\therefore -d=-2$
$\therefore d=2$

j) $2(3y+5)+xy=y(x+5)$
$\therefore 6y+10+xy=xy+5y$
$\therefore y=-10$

k) $2x(x+3)-5(x+4)=2x^2+5x-4$
$\therefore 2x^2+6x-5x-20=2x^2+5x-4$
$\therefore -4x=16$
$\therefore x=\dfrac{16}{-4}$
$\therefore x=-4$

Exercise 1 number 1 is on page **309**

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Exercise 2 Solutions:

1)

a) $\frac{5x}{4}-\frac{10x}{3}=15 \to \text{LCD}=12$

$\therefore 15x-40x=180$

$\therefore -25x=180$

$\therefore x=-\frac{180}{25}=-\frac{36}{5}$

b) $\frac{8x}{3}-2x=-\frac{2}{3} \to \text{LCD}=3$

$\therefore 8x-6x=-2$

$\therefore 2x=-2$

$\therefore x=-1$

c) $9a-\frac{3a}{4}=33 \to \text{LCD}=4$

$\therefore 36a-3a=132$

$\therefore 33a=132$

$\therefore a=4$

d) $\frac{5x}{3}+3=-\frac{2x}{5} \to \text{LCD}=15$

$\therefore 25x+45=-6x$

$\therefore 31x=-45$

$\therefore x=-\frac{45}{31}$

e) $\frac{b}{4}-\frac{2b}{3}+5=0 \to \text{LCD}=12$

$\therefore 3b-8b+60=0$

$\therefore -5b=-60$

$\therefore b=12$

f) $\frac{15r}{2}+4\frac{1}{2}=\frac{12r}{4} \to \text{LCD}=4$

$\therefore \frac{15r}{2}+\frac{9}{2}=\frac{12r}{4}$

$\therefore 30r+18=12r$

$\therefore 18r=-18$

$\therefore r=-1$

g) $\frac{15x}{2}-\frac{9x}{4}-1\frac{1}{2}=9 \to \text{LCD}=4$

$\therefore \frac{15x}{2}-\frac{9x}{4}-\frac{3}{2}=9$

$\therefore 30x-9x-6=36$

$\therefore 21x=42$

$\therefore x=2$

h) $\frac{x}{3}-2(x-1)=\frac{5x}{2}-3 \to \text{LCD}=6$

$\therefore 2x-12(x-1)=15x-18$

$\therefore 2x-12x+12=15x-18$

$\therefore -25x=-30$

$\therefore x=\frac{30}{25}=\frac{6}{5}$

i) $7q+\frac{21}{4}=7+\frac{7q}{2} \to \text{LCD}=4$

$\therefore 28q+21=28+14q$

$\therefore 14q=7$

$\therefore q=\frac{1}{2}$

j) $\frac{11x}{2}-\frac{3x}{5}=3-\frac{7x}{10} \to \text{LCD}=10$

$\therefore 55x-6x=30-7x$

$\therefore 56x=30$

$\therefore x=\frac{30}{56}=\frac{15}{28}$

Exercise 2 number 1 is on page **309**

2)

a) $\frac{x+2}{2}-\frac{x-3}{3}=x-\frac{1}{2} \to \text{LCD}=6$

$\therefore 3(x+2)-2(x-3)=6x-3(1)$

$\therefore 3x+6-2x+6=6x-3$

$\therefore -5x=-15$

$\therefore x=3$

b) $\frac{q+6}{5}+\frac{2q+1}{10}=3-\frac{1}{2} \to \text{LCD}=10$

$\therefore 2(q+6)+2q+1=10(3)-5(1)$

$\therefore 2q+12+2q+1=30-5$

$\therefore 4q=12$

$\therefore q=3$

c) $\frac{a+3}{4}-\frac{a}{2}=\frac{a+2}{8}-1 \to \text{LCD}=8$

$\therefore 2(a+3)-4a=a+2-8(1)$

$\therefore 2a+6-4a=a+2-8$

$\therefore -3a=-12$

$\therefore a=4$

d) $\frac{x+1}{3}-\frac{5x-1}{2}=-\frac{2x-4}{2} \to \text{LCD}=6$

$\therefore 2(x+1)-3(5x-1)=-3(2x-4)$

$\therefore 2x+2-15x+3=-6x+12$

$\therefore -7x=7$

$\therefore x=-1$

Exercise 2 number 2 is on page **309** (solutions are continued on the next page)

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e) $\frac{2q+1}{3}-\frac{q+2}{8}=\frac{3q+1}{4} \rightarrow \text{LCD}=24$

$\therefore 8(2q+1)-3(q+2)=6(3q+1)$

$\therefore 16q+8-3q-6=18q+6$

$\therefore -5q=4$

$\therefore q=-\frac{4}{5}$

f) $\frac{2x}{5}+\frac{2x-18}{3}+\frac{x}{3}=3x-2 \rightarrow \text{LCD}=15$

$\therefore 3(2x)+5(2x-18)+5x=15(3x-2)$

$\therefore 6x+10x-90+5x=45x-30$

$\therefore -24x=60$

$\therefore x=-\frac{60}{24}=-\frac{5}{2}$

g) $\frac{2x+5}{2}-\frac{x+1}{3}=\frac{1}{3}-\frac{x+5}{12} \rightarrow \text{LCD}=12$

$\therefore 6(2x+5)-4(x+1)=4(1)-(x+5)$

$\therefore 12x+30-4x-4=4-x-5$

$\therefore 9x=-27$

$\therefore x=-3$

h) $\frac{7x+3}{2}-\frac{x+3}{7}=\frac{5x+1}{14} \rightarrow \text{LCD}=14$

$\therefore 7(7x+3)-2(x+3)=5x+1$

$\therefore 49x+21-2x-6=5x+1$

$\therefore 42x=-14$

$\therefore x=-\frac{14}{42}=-\frac{1}{3}$

Exercise 2 number 2 is on page **309**

3)

a) $7+\frac{5}{x}=\frac{5(x+3)}{x} \rightarrow \text{LCD}=x,\ x\neq 0$

$\therefore 7x+5=5(x+3)$

$\therefore 7x+5=5x+15$

$\therefore 2x=10$

$\therefore x=5$

b) $\frac{3(x+2)}{x}+\frac{5}{2}=3+\frac{6}{x} \rightarrow \text{LCD}=2x,\ x\neq 0$

$\therefore 2(3)(x+2)+5x=2x(3)+2(6)$

$\therefore 6x+12+5x=6x+12$

$\therefore 5x=0$

$\therefore x=0 \rightarrow$ but $x\neq 0$

$\therefore$ No solution

c) $\frac{3(x-2)}{x}-\frac{5}{2}=\frac{2}{x}+\frac{1}{6} \rightarrow \text{LCD}=6x,\ x\neq 0$

$\therefore 6(3)(x-2)-3x(5)=6(2)+x(1)$

$\therefore 18x-36-15x=12+x$

$\therefore 2x=48$

$\therefore x=24$

d) $\frac{2}{5}-\frac{3(x+2)}{3x}-1=4-\frac{30}{15x} \rightarrow \text{LCD}=15x,\ x\neq 0$

$\therefore 3x(2)-5(3)(x+2)-15x(1)=15x(4)-30$

$\therefore 6x-15x-30-15x=60x-30$

$\therefore -84x=0$

$\therefore x=0 \rightarrow$ but $x\neq 0$

$\therefore$ No solution

Exercise 2 number 3 is on page **309**

<u>Exercise 3 Solutions</u>:

1)

a) $(x+3)(x-5)=0$

$\therefore x=-3$ or $x=5$

b) $(x+4)(x-5)=0$

$\therefore x=-4$ or $x=5$

c) $(a+7)(a-1)=0$

$\therefore x=-7$ or $a=1$

d) $(2x+1)(3x-4)=0$

$\therefore x=-\frac{1}{2}$ or $x=\frac{4}{3}$

e) $(5p+4)(2x+11)=0$

$\therefore p=-\frac{4}{5}$ or $x=-\frac{11}{2}$

f) $(9x-5)(7y-3)(2x+5)=0$

$\therefore x=\frac{5}{9}$ or $y=\frac{3}{7}$ or $x=-\frac{5}{2}$

g) $2^{(x+3)(x-5)}=1$

$\therefore 2^{(x+3)(x-5)}=2^0 \rightarrow 2^0=1$

$\therefore (x+3)(x-5)=0$

$\therefore x=-3$ or $x=5$

Exercise 3 number 1 is on page **309**

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2)

a) $x^2 + 5x = 0$
$\therefore x(x+5) = 0$
$\therefore x = 0 \quad \text{or} \quad x = -5$

b) $a^2 = 6a$
$\therefore a^2 - 6a = 0$
$\therefore a(a-6) = 0$
$\therefore a = 0 \quad \text{or} \quad a = 6$

c) $p^2 = -2p$
$\therefore p^2 + 2p = 0$
$\therefore p(p+2) = 0$
$\therefore p = 0 \quad \text{or} \quad p = -2$

d) $2x^2 - 4x = 0$
$\therefore 2x(x-2) = 0$
$\therefore x = 0 \quad \text{or} \quad x = 2$

e) $x^2 - 3x - 10 = 0$
$\therefore (x-5)(x+2) = 0$
$\therefore x = 5 \quad \text{or} \quad x = -2$

f) $m^2 + 9m + 14 = 0$
$\therefore (m+2)(m+7) = 0$
$\therefore m = -2 \quad \text{or} \quad m = -7$

g) $x^2 - 11x + 10 = 0$
$\therefore (x-10)(x-1) = 0$
$\therefore x = 10 \quad \text{or} \quad x = 1$

h) $r^2 + 2r = 8$
$\therefore r^2 + 2r - 8 = 0$
$\therefore (r+4)(r-2) = 0$
$\therefore r = -4 \quad \text{or} \quad r = 2$

i) $2w^2 - 6w - 36 = 0$
$\therefore 2(w^2 - 3w - 18) = 0$
$\therefore w^2 - 3w - 18 = 0$
$\therefore (w-6)(w+3) = 0$
$\therefore w = 6 \quad \text{or} \quad w = -3$

j) $2x^2 - 18x = 44$
$\therefore 2x^2 - 18x - 44 = 0$
$\therefore 2(x^2 - 9x - 22) = 0$
$\therefore x^2 - 9x - 22 = 0$
$\therefore (x-11)(x+2) = 0$
$\therefore x = 11 \quad \text{or} \quad x = -2$

k) $3x^2 = 6x + 72$
$\therefore 3x^2 - 6x - 72 = 0$
$\therefore 3(x^2 - 2x - 24) = 0$
$\therefore x^2 - 2x - 24 = 0$
$\therefore (x-6)(x+4) = 0$
$\therefore x = 6 \quad \text{or} \quad x = -4$

l) $-72y = -3y^2 + 75$
$\therefore 3y^2 - 72y - 75 = 0$
$\therefore 3(y^2 - 24y - 25) = 0$
$\therefore y^2 - 24y - 25 = 0$
$\therefore (y-25)(y+1) = 0$
$\therefore y = 25 \quad \text{or} \quad y = -1$

Exercise 3 number 2 is on page **310**

3)

a) $(x-4)(x-6) = 24$
$\therefore x^2 - 10x + 24 = 24$
$\therefore x^2 - 10x = 0$
$\therefore x(x-10) = 0$
$\therefore x = 0 \quad \text{or} \quad x = 10$

b) $2(x-2)^2 = 32$
$\therefore 2(x^2 - 4x + 4) = 32$
$\therefore 2x^2 - 8x + 8 = 32$
$\therefore 2x^2 - 8x - 24 = 0$
$\therefore 2(x^2 - 4x - 12) = 0$
$\therefore x^2 - 4x - 12 = 0$
$\therefore (x-6)(x+2) = 0$
$\therefore x = 6 \quad \text{or} \quad x = -2$

c) $(x-3)(x-4) = 72$
$\therefore x^2 - 7x + 12 = 72$
$\therefore x^2 - 7x - 60 = 0$
$\therefore (x-12)(x+5) = 0$
$\therefore x = 12 \quad \text{or} \quad x = -5$

d) $(x-2)(x+1) = 18$
$\therefore x^2 - x - 2 = 18$
$\therefore x^2 - x - 20 = 0$
$\therefore (x-5)(x+4) = 0$
$\therefore x = 5 \quad \text{or} \quad x = -4$

e) $3(x-1)^2 - 75 = 0$

Method 1:
$\therefore 3\left[(x-1)^2 - 25\right] = 0$
$\therefore (x-1)^2 - 25 = 0$
$\therefore x^2 - 2x + 1 - 25 = 0$
$\therefore x^2 - 2x - 24 = 0$
$\therefore (x-6)(x+4) = 0$
$\therefore x = 6 \quad \text{or} \quad x = -4$

Method 2:
$\therefore 3\left[(x-1)^2 - 25\right] = 0$
$\therefore (x-1)^2 - 25 = 0$
$\therefore (x-1-5)(x-1+5) = 0$
$\therefore (x-6)(x+4) = 0$
$\therefore x = 6 \quad \text{or} \quad x = -4$

f) $(x-3)(x+8) + 30 = 0$
$\therefore x^2 + 5x - 24 + 30 = 0$
$\therefore x^2 + 5x + 6 = 0$
$\therefore (x+3)(x+2) = 0$
$\therefore x = -3 \quad \text{or} \quad x = -2$

Exercise 3 number 3 is on page **310**

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Exercise 4 Solutions:

1)

a) Let the number = x

$3x-5=31$

$\therefore 3x=36$

$\therefore x=12$

b) Let the number = x

$14x-8=20$

$\therefore 14x=28$

$\therefore x=2$

c) Let the number = x

$4x+5=2x+5$

$\therefore 2x=0$

$\therefore x=0$

d) Let the 1st number = x

$\therefore$ the 2nd number = $x+2$

$\therefore$ the 3rd number = $x+4$

$x+x+2+x+4=60$

$\therefore 3x+6=60$

$\therefore 3x=54$

$\therefore x=18$

$\therefore$ the numbers are 18, 20 and 22.

e) Let the 1st number = x

$\therefore$ the 2nd number = $x+2$

$\therefore$ the 3rd number = $x+4$

$x+x+2+x+4=27$

$\therefore 3x+6=27$

$\therefore 3x=21$

$\therefore x=7$

$\therefore$ the numbers are 7, 9 and 11.

f) Let Natasha's age = x

$\therefore$ Joseph's age = $x+6$

$\therefore x+x+6=50$

$\therefore 2x=44$

$\therefore x=22$

$\therefore$ Natasha is 22 years old and Joseph is 28 years old.

g) Let the son's age = x

$\therefore$ Harry's age = $7x$

$\therefore x(7x)=175$

$\therefore 7x^2=175$

$\therefore x^2=25$

$\therefore x^2-25=0$

$\therefore (x-5)(x+5)=0$

$\therefore x=5$ or $x\neq -5 \rightarrow$ age cannot be negative

$\therefore x=5$

$\therefore$ The son is 5 years old and Harry is 35 years old.

h) Let the son's age = x

$\therefore$ The father's age = $x+30$

Three years ago:

The son's age = $x-3$

The father's age $=x+30-3$

$=x+27$

$\therefore x+27=3(x-3)$

$\therefore x+27=3x-9$

$\therefore -2x=-36$

$\therefore x=18$

$\therefore$ The son is 18 years old and the father is 48 years old.

Exercise 4 number 1 is on page 310

2)

a) Lollipops sold = $x-5$

b) Amount received = Price per lollipop × number of lollipops sold

$\therefore 190=2(x-5)$

$\therefore 190=2x-10$

$\therefore -2x=-200$

$\therefore x=100$ lollipops to sell

$\therefore$ 95 lollipops were sold

Exercise 4 number 2 is on page 310

3) AB = x

$\therefore$ BC = $x+3$

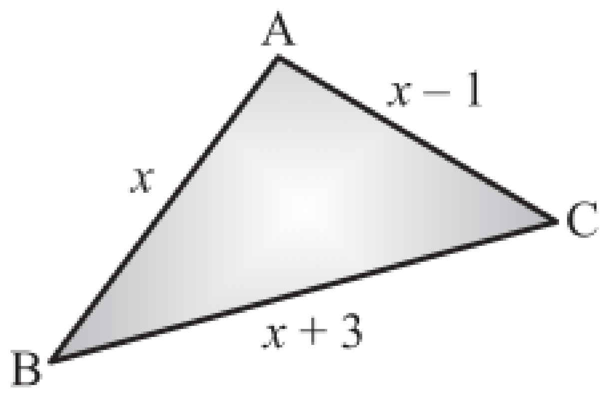
$\therefore$ AC = $x-1$

AB + BC + AC = Perimeter

$\therefore x+x+3+x-1=14$

$\therefore 3x=12$

$\therefore x=4$cm



Exercise 4 number 3 is on page 310

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4)

a) $$\text{speed}_{\text{from Johannesburg to Cape Town}} = \frac{\text{distance}}{\text{time}} = \frac{x}{2,5}$$

b) $$\text{speed}_{\text{from Cape Town to Johannesburg}} = \frac{\text{distance}}{\text{time}} = \frac{x}{2}$$

c) $$\text{speed}_{\text{Cape Town to Johannesburg}} - \text{speed}_{\text{Johannesburg to Cape Town}} = 140 \rightarrow \text{faster speed} - \text{slower speed}$$

$$\therefore \frac{x}{2} - \frac{x}{2,5} = 140 \rightarrow \text{LCD} = 10$$

$$\therefore 5x - 4x = 1400$$

$$\therefore x = 1400\,\text{km}$$

d) $$\text{speed}_{\text{from Johannesburg to Cape Town}} = \frac{x}{2,5} = \frac{1400}{2,5} = 560\,\text{km/h}$$

Exercise 4 number 4 is on page **310**

5)

a) Let the 1st number = x

$\therefore$ the 2nd number = $x + 1$

$x(x+1) = 132$

$\therefore x^2 + x - 132 = 0$

$\therefore (x-11)(x+12) = 0$

$\therefore x = 11 \quad \text{or} \quad x \neq -12 \rightarrow$ the numbers are positive

$\therefore$ the numbers are 11 and 12

b) Let the 1st number = x

$\therefore$ the 2nd number = $x + 2$

$x(x+2) = 48$

$\therefore x^2 + 2x - 48 = 0$

$\therefore (x+8)(x-6) = 0$

$\therefore x = -8 \quad \text{or} \quad x \neq 6 \rightarrow$ the numbers are negative

$\therefore$ the numbers are -8 and -6

c) Let Lauren's age = x

$\therefore$ Nawaz's age = $x + 3$

$\therefore x(x+3) = 54$

$\therefore x^2 + 3x - 54 = 0$

$\therefore (x-6)(x+9) = 0$

$\therefore x = 6 \quad \text{or} \quad x \neq -9 \rightarrow$ age cannot be negative

$\therefore$ Lauren is 6 and Nawaz is 9

Exercise 4 number 5 is on page **310**

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6) Area = length × breadth

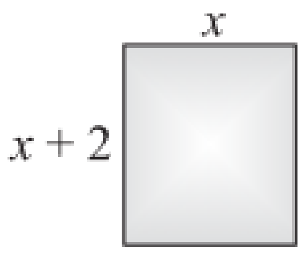
$\therefore 15 = x(x+2)$

$\therefore 0 = x^2 + 2x - 15$

$\therefore 0 = (x-3)(x+5)$

$\therefore x = 3 \quad \text{or} \quad x \neq -5 \rightarrow$ length cannot be negative

$\therefore$ the length of the room is 3 metres and the width of the room is 5 metres



Exercise 4 number 6 is on page **310**

<u>Mixed Exercise Solutions</u>:

1)

a) $3x + 5 = 8x - 4$

$-5x = -9$

$\therefore x = \dfrac{9}{5}$

b) $\dfrac{x-3}{3} - \dfrac{2x+1}{2} = 4x - 3 \rightarrow \text{LCD} = 6$

$\therefore 2(x-3) - 3(2x+1) = 6(4x) - 6(3)$

$\therefore 2x - 6 - 6x - 3 = 24x - 18$

$\therefore -28x = -9$

$\therefore x = \dfrac{9}{28}$

c) $\dfrac{x}{12} - 1 - \dfrac{x+2}{3} = -\dfrac{3x}{4} \rightarrow \text{LCD} = 12$

$\therefore x - 12(1) - 4(x+2) = -3(3x)$

$\therefore x - 12 - 4x - 8 = -9x$

$\therefore 6x = 20$

$\therefore x = \dfrac{20}{6} = \dfrac{10}{3}$

d) $\dfrac{(2a+3)(b-5)}{1250860} = 0$

$\therefore (2a+3)(b-5) = 0$

$\therefore a = -\dfrac{3}{2} \quad \text{or} \quad b = 5$

e) $(x+3)^2 = x^2 + 9$

$\therefore x^2 + 6x + 9 = x^2 + 9$

$\therefore 6x = 0$

$\therefore x = 0$

f) $(2y+3)(2y-3) = 4y^2 + 9$

$\therefore 4y^2 - 9 = 4y^2 + 9$

$\therefore 0 = 18$

$\therefore$ no solution

g) $2(x+2) = 3(3x-4)$

$\therefore 2x + 4 = 9x - 12$

$\therefore -7x = -16$

$\therefore x = \dfrac{16}{7}$

h) $4^{y+1} = 8$

$\therefore (2)^{2y+2} = 2^3$

$\therefore 2y + 2 = 3$

$\therefore 2y = 1$

$\therefore y = \dfrac{1}{2}$

i) $\dfrac{3-x}{4} = -5 \rightarrow \text{LCD} = 4$

$\therefore 3 - x = -20$

$\therefore -x = -23$

$\therefore x = 23$

j) $4 \times 4^x = 65\,536$

$\therefore 4^x = 16\,384$

$\therefore 2^{2x} = 2^{14}$

$\therefore 2x = 14$

$\therefore x = 7$

k) $\dfrac{x+1}{2} - \dfrac{2x}{3} = 1 \rightarrow \text{LCD} = 6$

$\therefore 3(x+1) - 2(2x) = 6(1)$

$\therefore 3x + 3 - 4x = 6$

$\therefore -x = 3$

$\therefore x = -3$

l) $3 \times 2^x = 24$

$\therefore 2^x = 8$

$\therefore 2^x = 2^3$

$\therefore x = 3$

m) $\dfrac{1-x}{3x} + \dfrac{1}{9} = \dfrac{x+3}{9x} \rightarrow \text{LCD} = 9x, \quad x \neq 0$

$\therefore 3(1-x) + x(1) = x + 3$

$\therefore 3 - 3x + x = x + 3$

$\therefore -3x = 0$

$\therefore x = 0$

but $x \neq 0$

$\therefore$ no solution

The Mixed Exercise number 1 is on page **311**

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2)

a) $x^2 = 4x^2$

$\therefore 0 = 3x^2$

$\therefore x = 0$

b) $x^3 - 4x = 0$

$\therefore x^2(x-4) = 0$

$\therefore x = 0 \quad \text{or} \quad x = 4$

c) $(x-1)(x+8) = -14$

$\therefore x^2 + 7x + 6 = 0$

$\therefore (x+1)(x+6) = 0$

$\therefore x = -1 \quad \text{or} \quad x = -6$

d) $2(x+2) = 3(3x-4)$

$2x + 4 = 9x - 12$

$\therefore -7x = -16$

$\therefore x = \dfrac{16}{7}$

e) $(x-3)^2 - 2(x+1) = (x-1)(x+4)$

$\therefore x^2 - 6x + 9 - 2x - 2 = x^2 + 3x - 4$

$\therefore -11x = -11$

$\therefore x = 1$

The Mixed Exercise number 2 is on page **311**

3) $x^2 - 4 = \text{A}(x-2)$

$\therefore (x+2)(x-2) = \text{A}(x-2)$

$\therefore \text{A} = x + 2$

$\text{C} = (x-2)(x+2)$

$\therefore \text{C} = x^2 - 4$

$\text{B} = \text{A}(x+2)$

$\therefore \text{B} = (x+2)(x+2)$

$\therefore \text{B} = x^2 + 4x + 4$

The Mixed Exercise number 3 is on page **311**

4)

a)

	Speed (km/h)	Distance (km)	Time (h)
Walking	5	x	$\dfrac{x}{5}$
Driving	30	$15 - x$	$\dfrac{15-x}{30}$

b) To convert hours to minutes divide by 60:

$90 \text{ minutes} = \dfrac{90}{60} \text{ hours}$

$= 1{,}5 \text{ hours}$

c) $\dfrac{x}{5} + \dfrac{15-x}{30} = 1{,}5 \rightarrow \text{LCD} = 30$

$\therefore 6x + 15 - x = 1{,}5(30)$

$\therefore 5x = 30$

$\therefore x = 6 \text{ km}$

The Mixed Exercise number 4 is on page **312**

5)

	Now	In x year's
Mother's age	46	$46 + x$
Daughter's age	19	$19 + x$

$\therefore 46 + x = 2(19 + x)$

$\therefore 46 + x = 38 + 2x$

$\therefore 8 = x$

$\therefore$ In 8 year's time the mother will be twice as old as her daughter

The Mixed Exercise number 5 is on page **312**

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6)

a) $y = 2(-3) + 5$

$= -1$

b) $-8 = 2x + 5$

$\therefore -13 = 2x$

$\therefore x = -\frac{13}{2}$

c) $12 = 2x + 5$

$\therefore 7 = 2x$

$\therefore x = \frac{7}{2}$

d) $y = 2(20) + 5$

$= 45$

The Mixed Exercise number 6 is on page **312**

7)

a) $x \neq -2$

b) $\frac{(x+2)(x+3)}{x+2} = 1 \rightarrow \text{LCD} = x + 2$

$\therefore (x+2)(x+3) = 1(x+2)$

$\therefore x^2 + 5x + 6 = x + 2$

$\therefore x^2 + 4x + 4 = 0$

$\therefore (x+2)(x+2) = 0$

$\therefore x = -2$

but $x \neq -2$

$\therefore$ there is no solution

The Mixed Exercise number 7 is on page **312**

8) $x^2 - y^2 = 15$

$\therefore (x+y)(x-y) = 15$

$\therefore (x+y)(5) = 15 \rightarrow$ divide both sides by 5

$\therefore x + y = 3$

9)

a) Number of adults $= 60\,000 - x$

b) Total cost = (number of Adults)(cost per adult ticket) + (number of children)(cost per children's ticket)

$\therefore 25\,000\,000 = 550(60\,000 - x) + 350(x)$

$\therefore 25\,000\,000 = 33\,000\,000 - 550x + 350x$

$\therefore 200x = 8\,000\,000$

$\therefore x = 40\,000$ children's tickets

$\therefore$ Adult's tickets $= 60\,000 - 40\,000$

$= 20\,000$ Adult tickets

The Mixed Exercise number 9 is on page **312**

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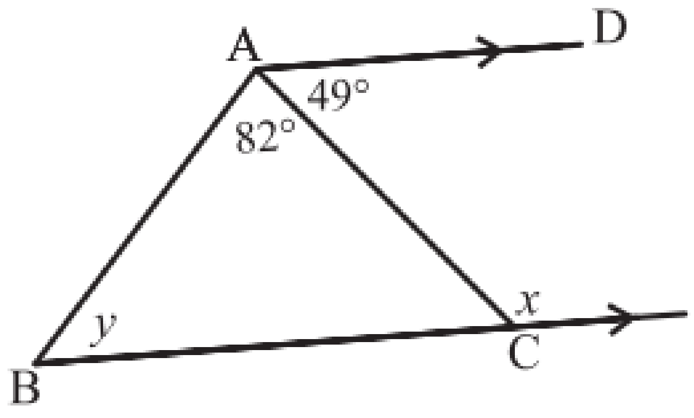
Chapter 12 – Geometry of 2D Shapes

Grade 8 Revision (from pages 121 - 125)

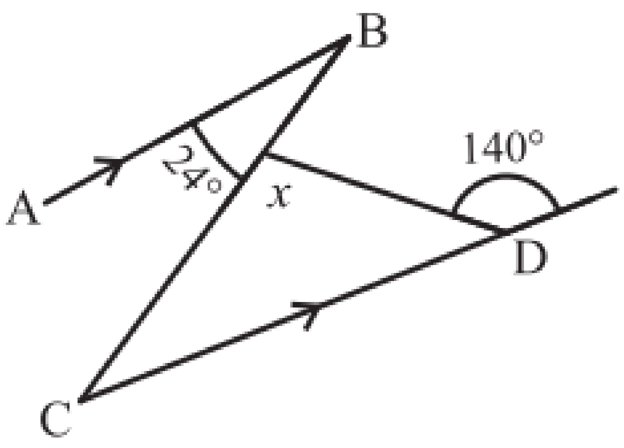
<u>Exercise 1</u>:

1) Determine the values of *x*, *y* and *z* in the diagrams below:

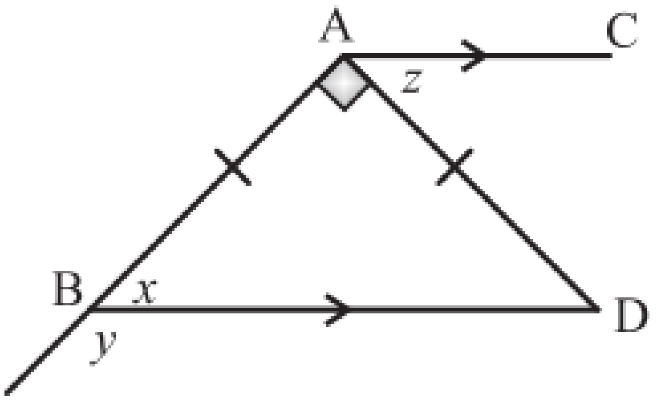
a)



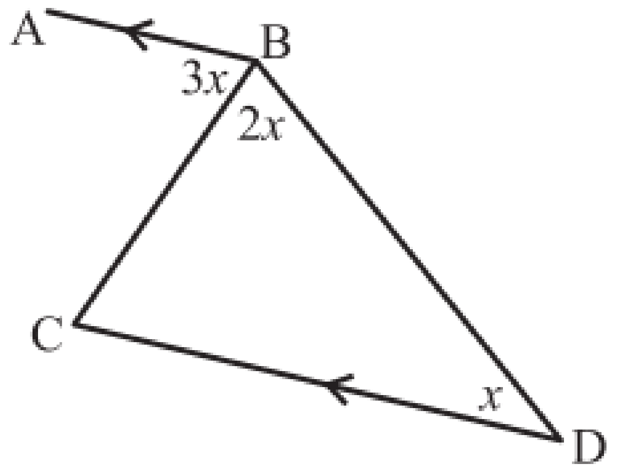
b)



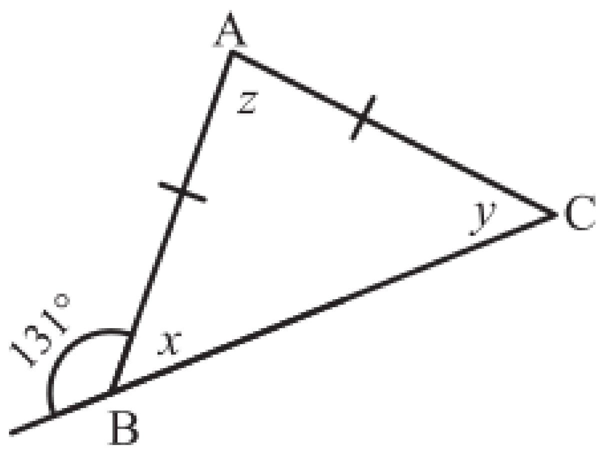
c)



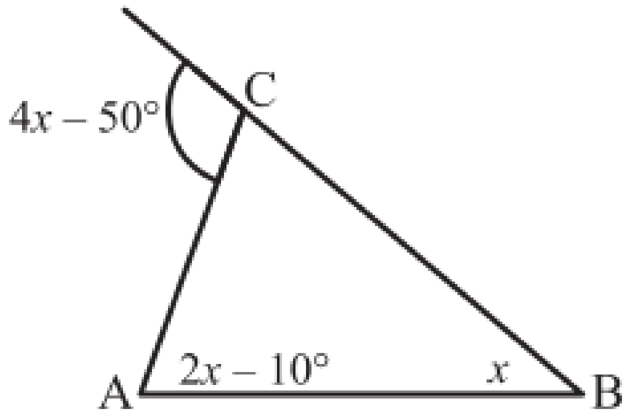
d)



e)



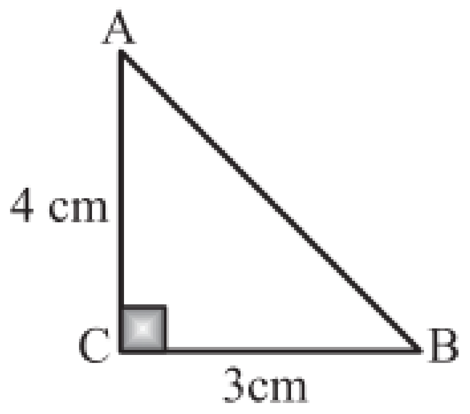
f)



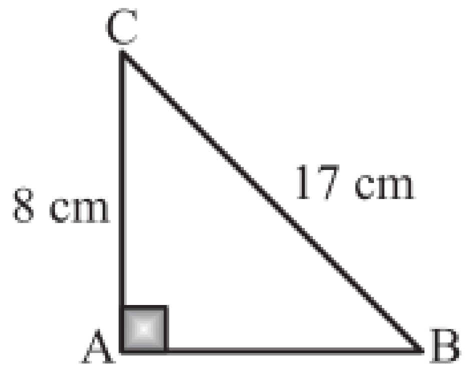
Solutions to Exercise 1 number 1 are on page **328**

2) Determine the length of AB in each of the following triangles:

a)



b)

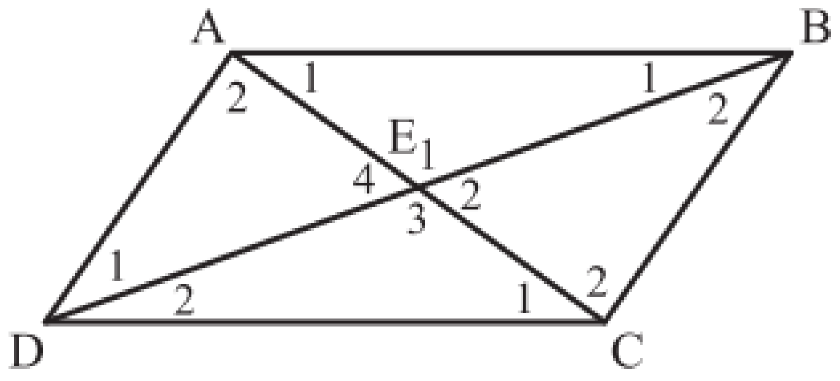


Solutions to Exercise 1 number 2 are on page **328**

Quadrilaterals (from pages 126 - 128)

<u>Exercise 2</u>:

1) ABCD shown below is a parallelogram and $\hat{B}$ is acute.



State whether the following statements are true or false:

a) AB // CD

b) $\hat{A} = \hat{C}$

c) $\hat{A}_1 = \hat{A}_2$

d) BE = CE

e) $AC \perp BD$

f) $\hat{C}$ is acute

Solutions to Exercise 2 number 1 are on page **328**

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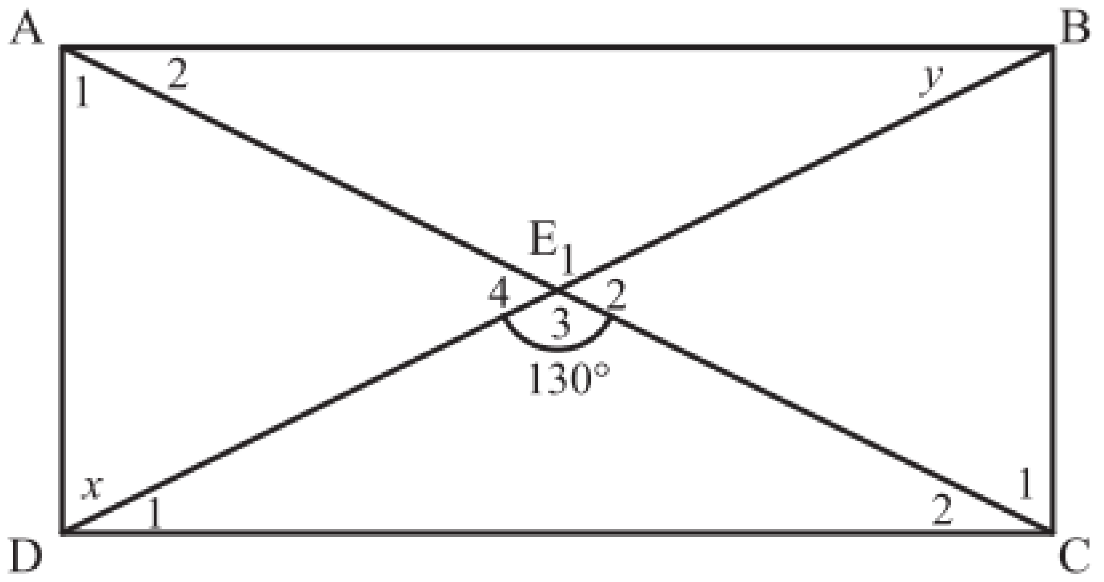
2) The shape shown below is a rectangle. It is given that $\hat{E}_3 = 130°$.



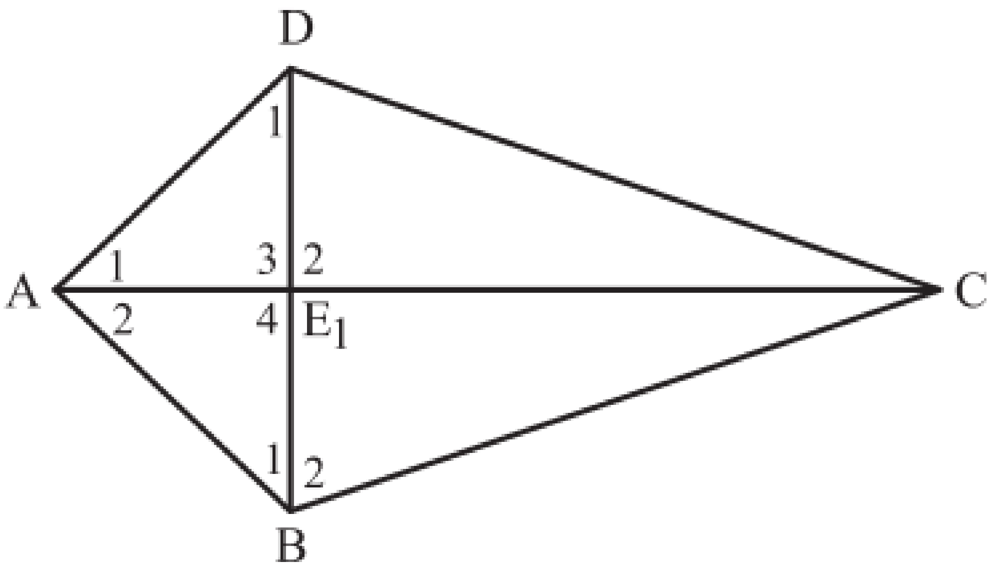
a) Determine the value of *y*.

b) Determine the value of *x*.

c) If DC = 12mm and AD = 5mm, determine the length of BE.

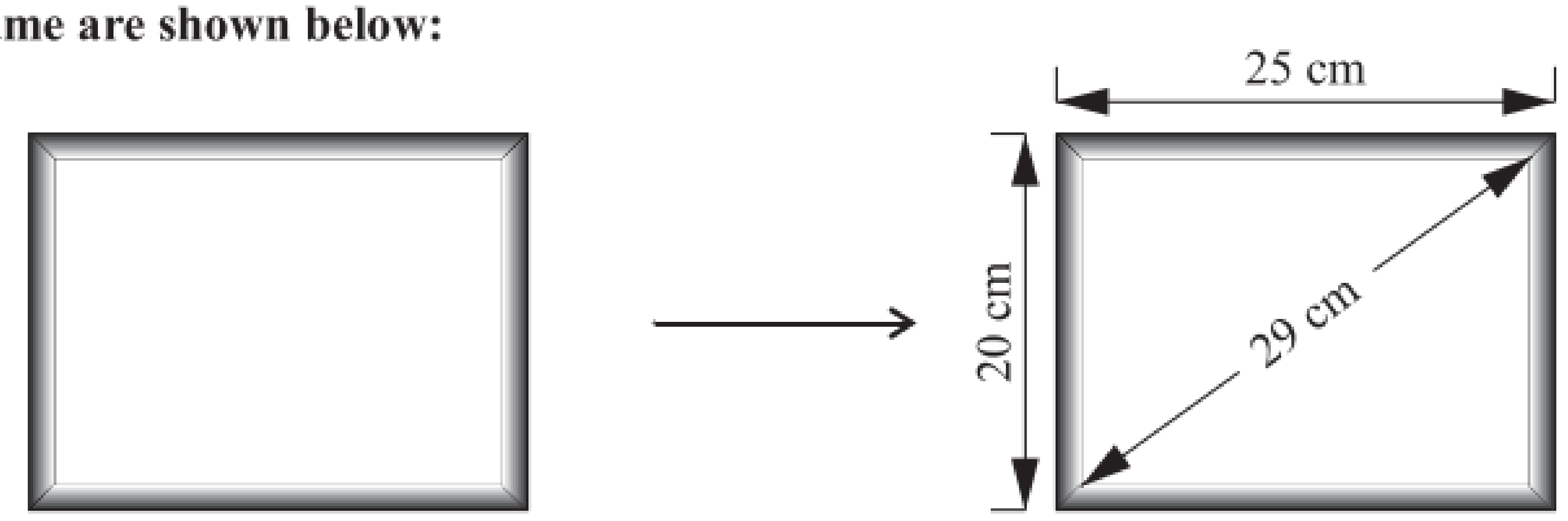
Solutions to Exercise 2 number 2 are on page **328**

3) In the kite shown below AD = 25cm, BD = 48cm, DC = 145cm. determine the length of diagonal AC.



Solutions to Exercise 2 number 3 are on page **329**

4) Ben wishes to construct a rectangular wooden photo frame. He does not have any tools to measure angles. His photo frame must fit a picture which has a diagonal length of 29cm. The plans for Ben's photo frame are shown below:

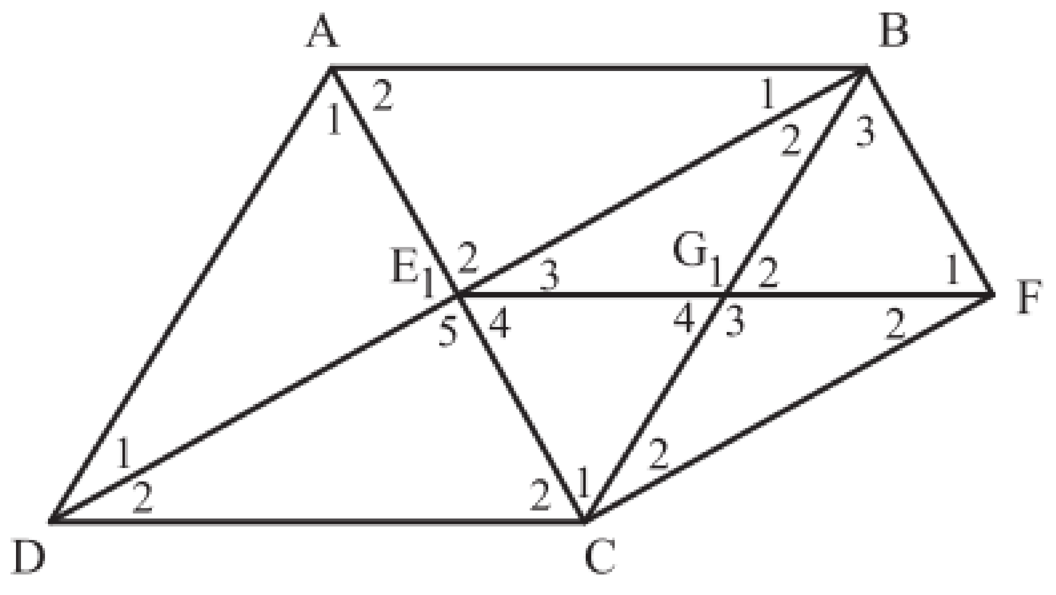


a) Tuli examines the drawings and states that Ben's frame couldn't possibly be a rectangle. Is she correct? Substantiate your answer with calculations.

b) Tuli says that Ben should make the length of his photo frame 21cm. Is she correct?

Solutions to Exercise 2 number 4 are on page **329**

5) In the diagram below, ABCD is a rhombus and BECF is a rectangle. It is given that $D\hat{B}C = 60°$, BG = 2,5cm and EC = 3cm.



a) Determine the size of angle $\hat{B}_3$.

b) Complete the following sentence: The diagonals of a rhombus bisect each other at ____ and the diagonals of a rectangle ________ each other

c) Determine the length of diagonal BD.

Solutions to Exercise 2 number 5 are on page **329**

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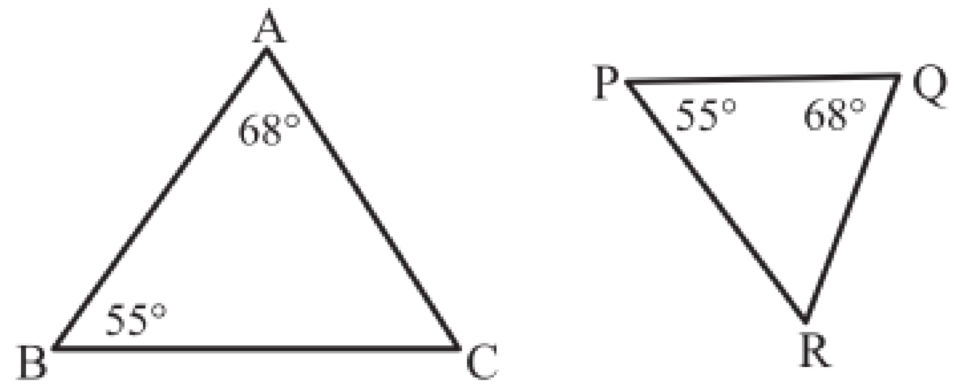
Similarity (from pages 129 - 132)

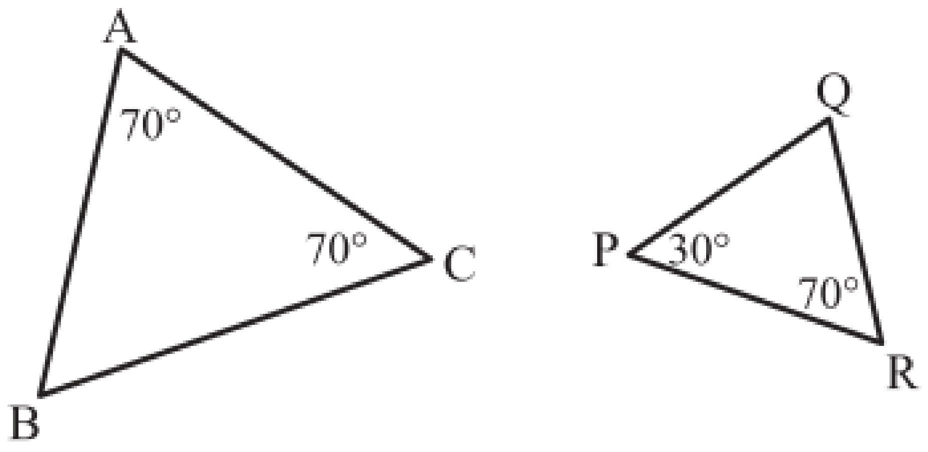
Exercise 3:

1) State whether the triangle pairs shown below are similar. If the triangles are similar state the triangle pairs in the correct order.

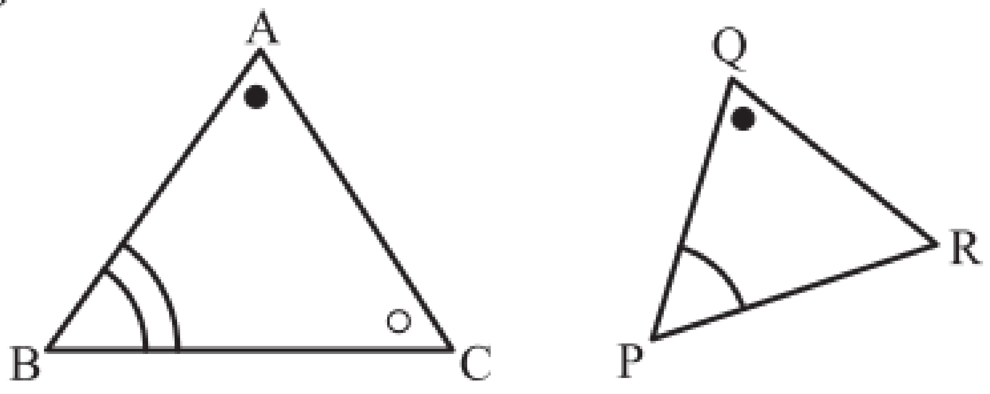
a)



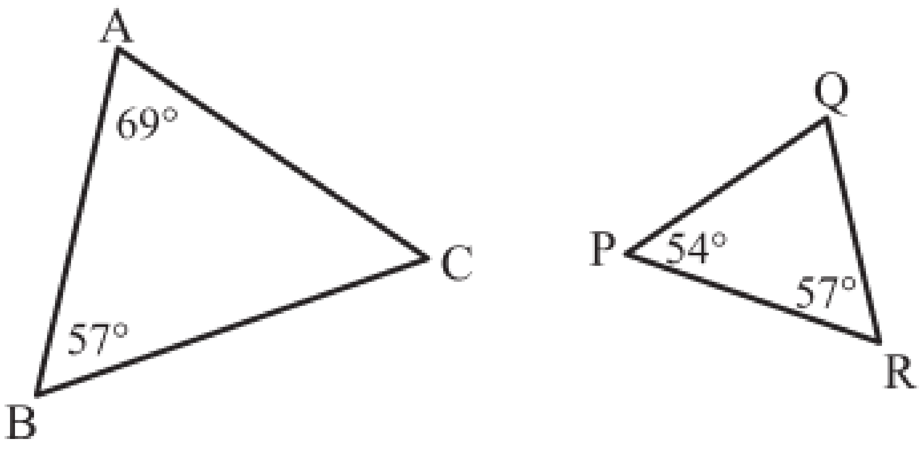
c)



b)

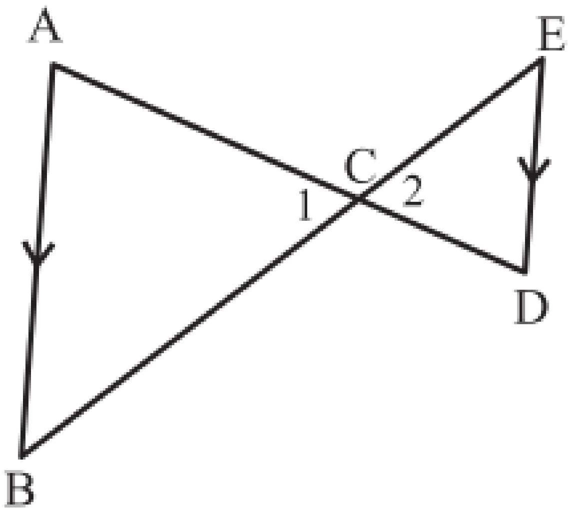


d)



Solutions to Exercise 3 number 1 are on page 329

2) In the diagram below AB//ED.

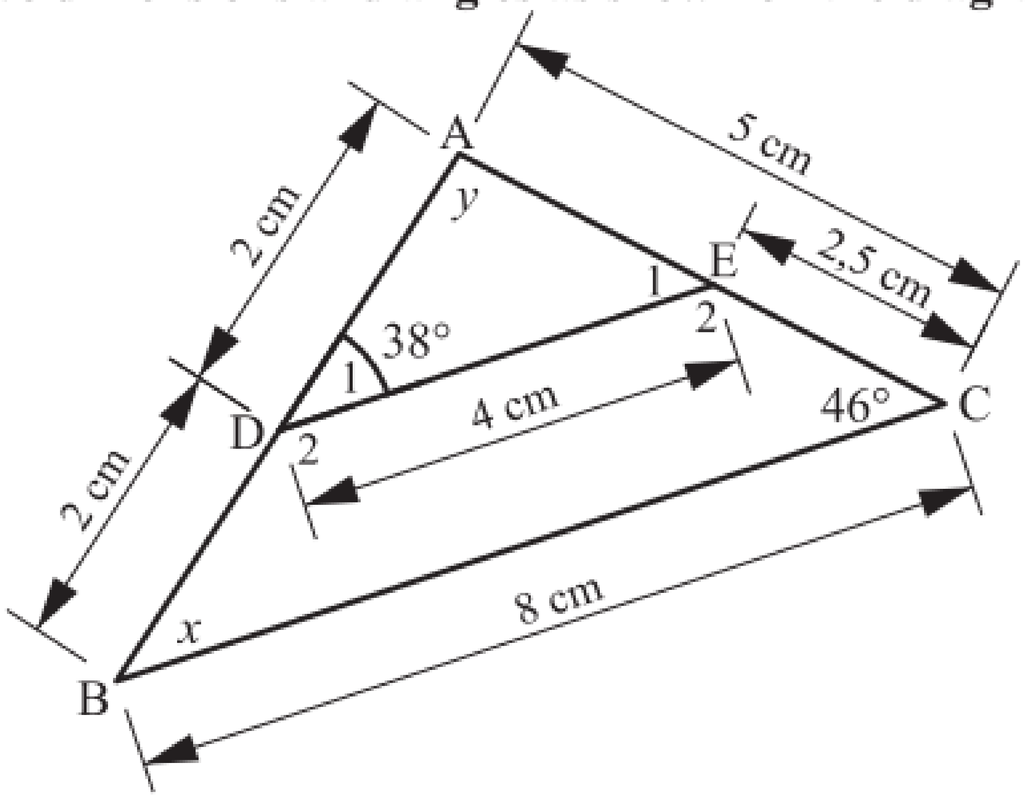


a) Prove that △ABC///△DEC.

b) If AB = 32 units, ED = 8 units and CD = 4 units, determine the length of AC.

Solutions to Exercise 3 number 2 are on page 330

3) The triangles below have dimensions and angles as shown on the diagram.

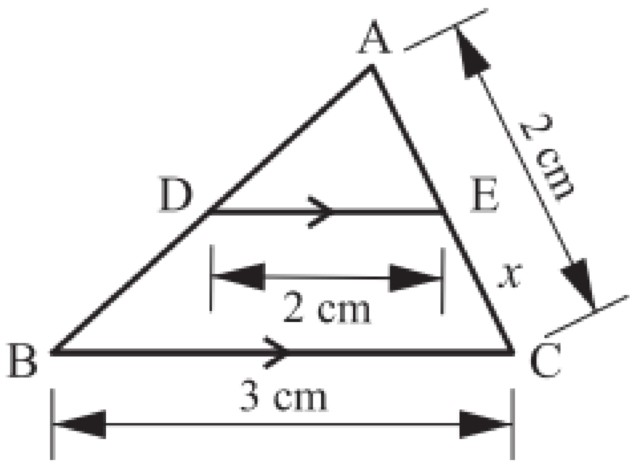


a) Prove that △ABC///△ADE.

b) Hence, determine the value of x and y.

Solutions to Exercise 3 number 3 are on page 330

4) In the diagram below DE//BC. DE = 2cm, BC = 3cm and AC = 2cm. Determine the value of x.



Solutions to Exercise 3 number 4 are on page 330

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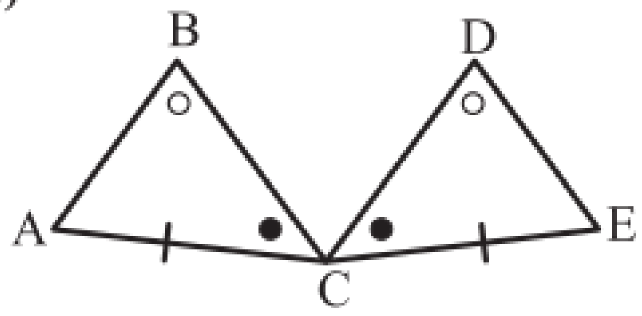
Congruency (from pages 133 - 136)

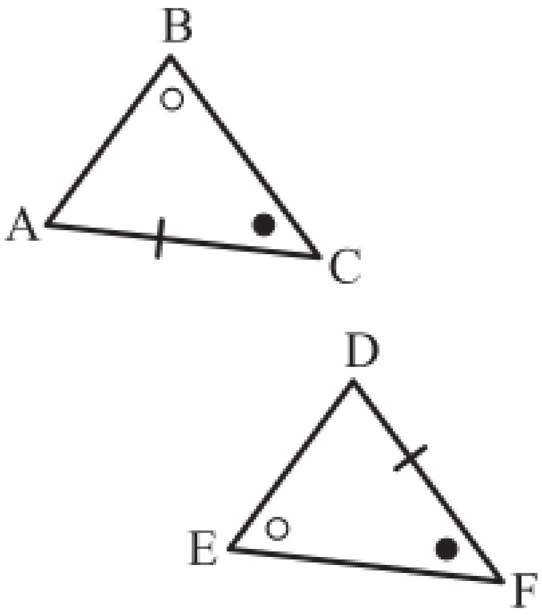
Exercise 4:

1) **For each of the triangle pairs shown below, state whether the pairs are congruent. If they are congruent, state the congruent triangles in their corresponding order as well as the case for congruency.**

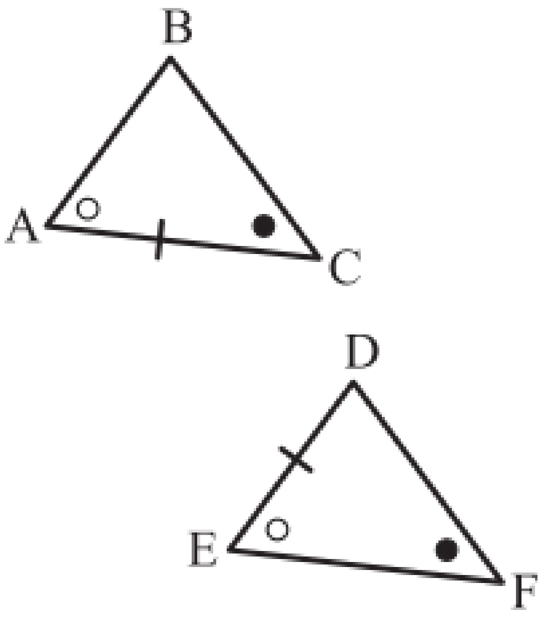
a)



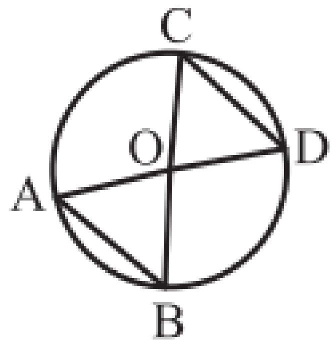
b)



c)

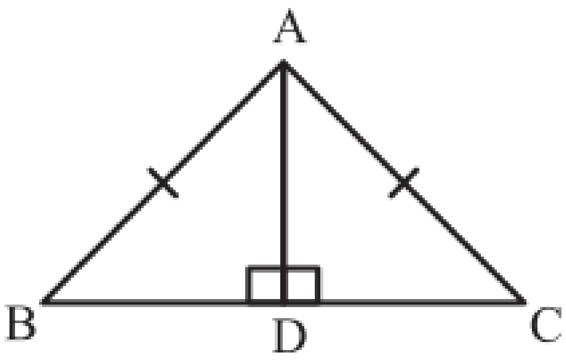


d)

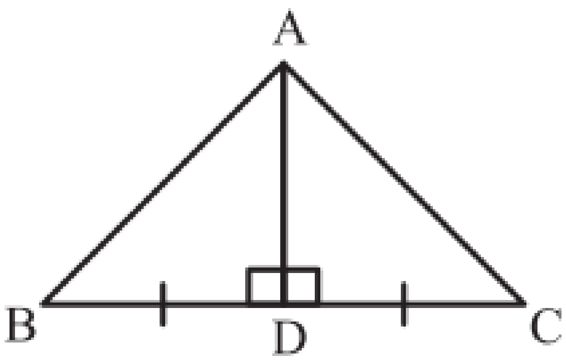


O is the centre of the circle

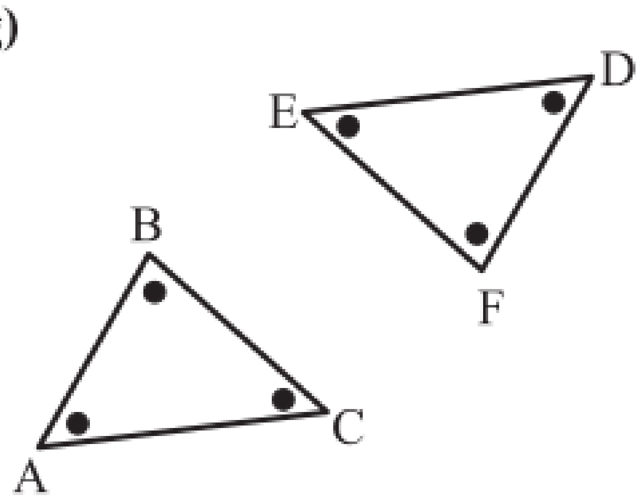
e)



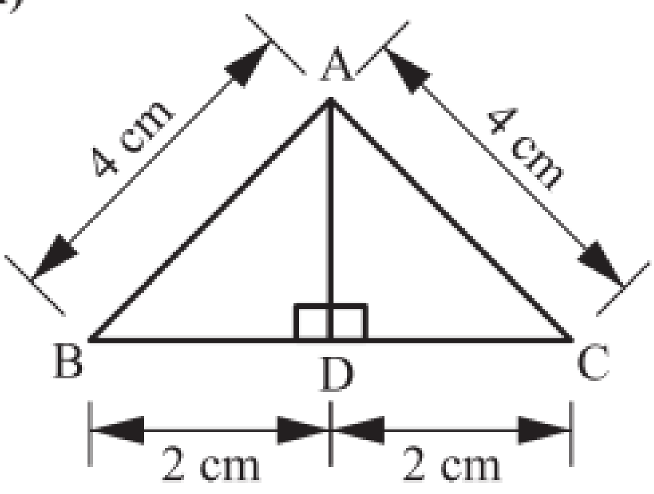
f)



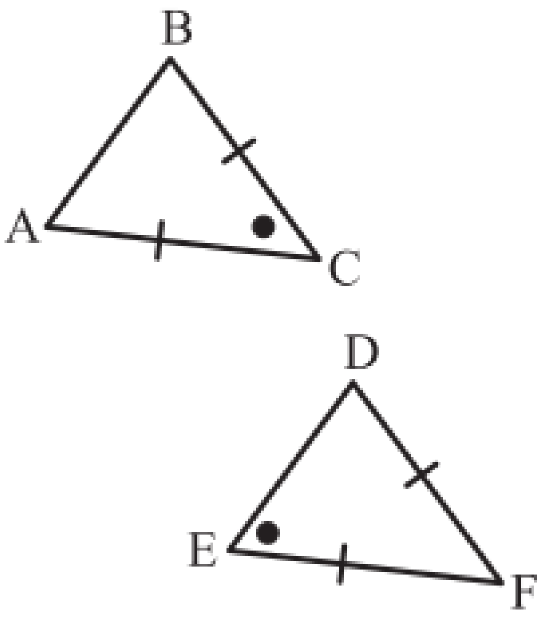
g)



h)

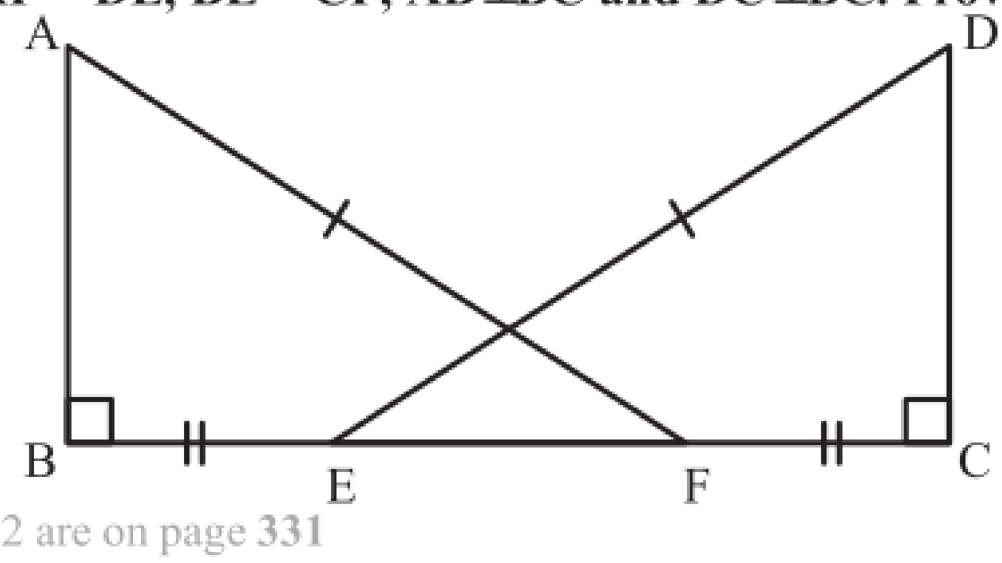


i)



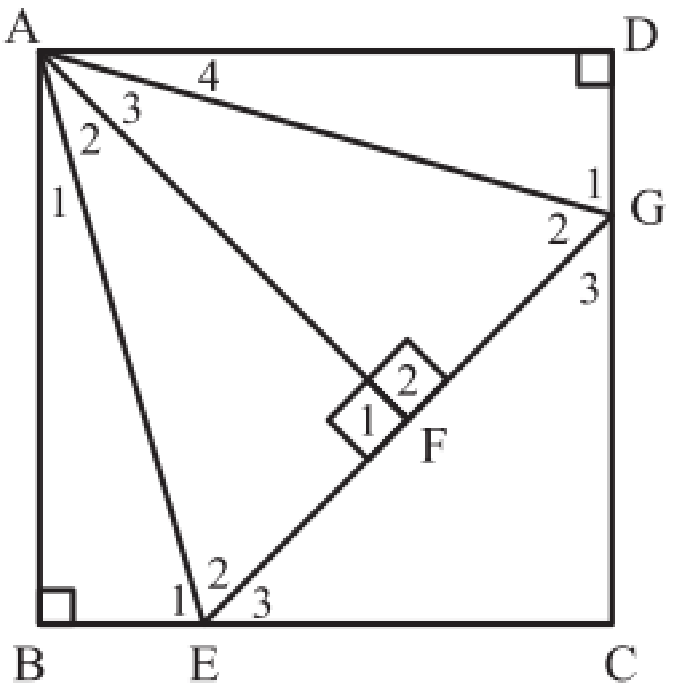
Solutions to Exercise 4 number 1 are on page **331**

2) **In the diagram below AF = DE, BE = CF, AB ⊥ BC and DC ⊥ BC. Prove that ΔABF ≡ ΔDEC.**



Solutions to Exercise 4 number 2 are on page **331**

3) **In the diagram below, ABCD is a square with BE = DG and AF ⊥ EG.**



a) Prove that AE = AG.

b) Prove that ΔAEF ≡ ΔAGF.

Solutions to Exercise 4 number 3 are on page 331

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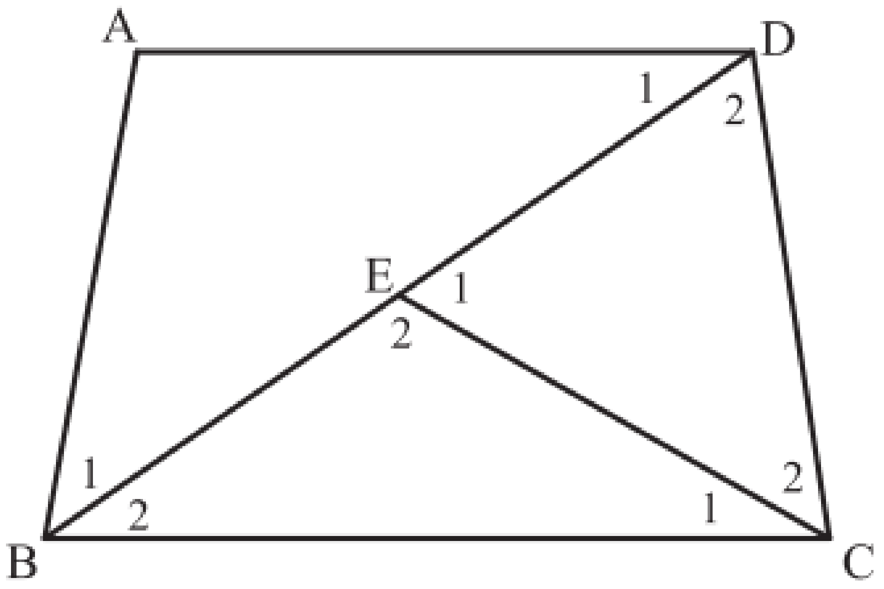
4) ABCD below is a trapezium and BDC is an isosceles triangle. DC ≠ BC and $\hat{E}_2 = \hat{A}$.



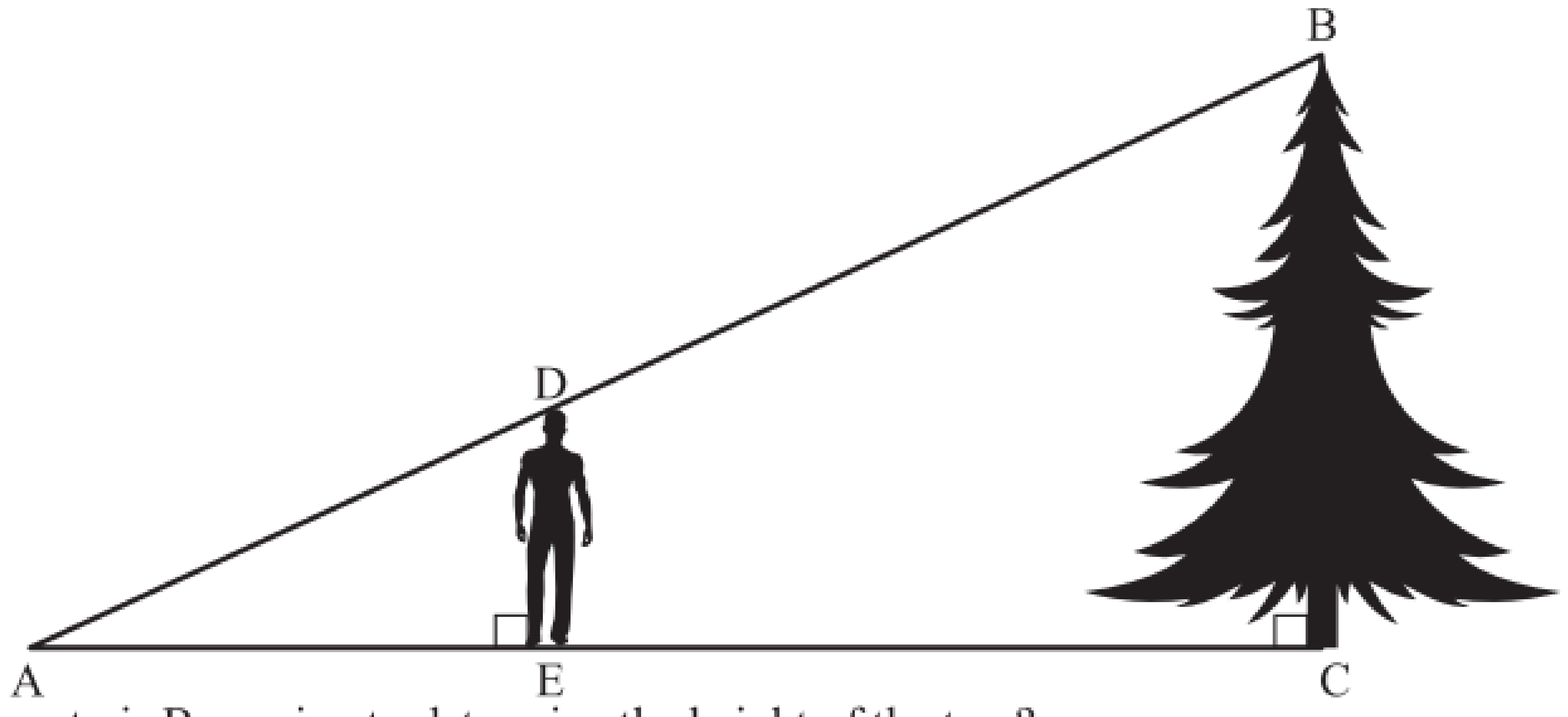
a) Prove that $\triangle ADB \equiv \triangle EBC$.

b) Hence, if $\hat{E}_1 = 64^\circ$ and $\hat{B}_2 = 34^\circ$, determine the size of $\hat{B}_1$.

Solutions to Exercise 4 number 4 are on page 331

Mixed Exercise:

1) Joseph is trying to determine the height of tree BC. He knows his friend Ben is 2 meters tall. Joseph shines a laser from point A on the ground to the top of the tree. He asks Ben to walk towards him until the top of his head touches the laser beam. This is shown in the diagram below.

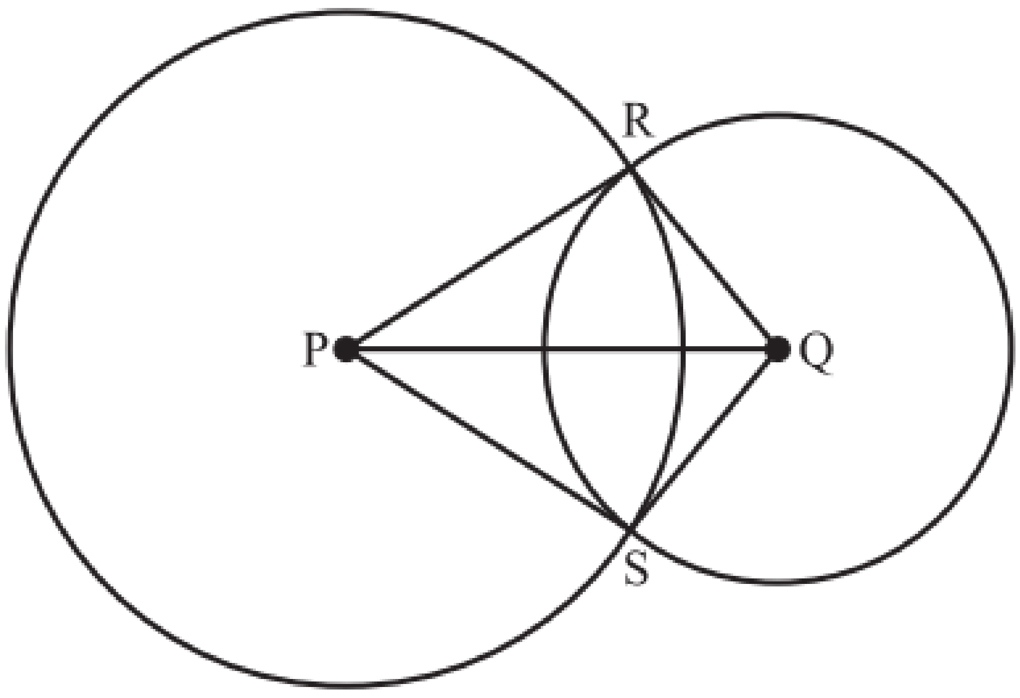


a) What property is Ben using to determine the height of the tree?

b) When the laser touches Ben's head at D, Ben is 3 metres from point A and 27 metres from the base of the tree. How tall is the tree?

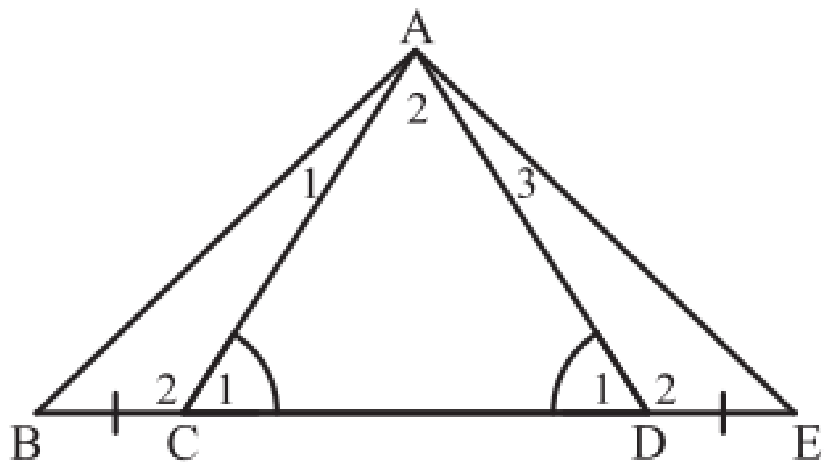
Solutions to the Mixed Exercise number 1 are on page 332

2) In the diagram below P and Q are the centres of their respective circles. Prove that $\triangle PRQ \equiv \triangle PSQ$.



Solutions to the Mixed Exercise number 2 are on page 332

3) In the figure below $\hat{C}_1 = \hat{D}_1$ and BC = DE. Prove that AB = AE. (Hint: first prove that $\hat{C}_2 = \hat{D}_2$)



Solutions to the Mixed Exercise number 3 are on page 332

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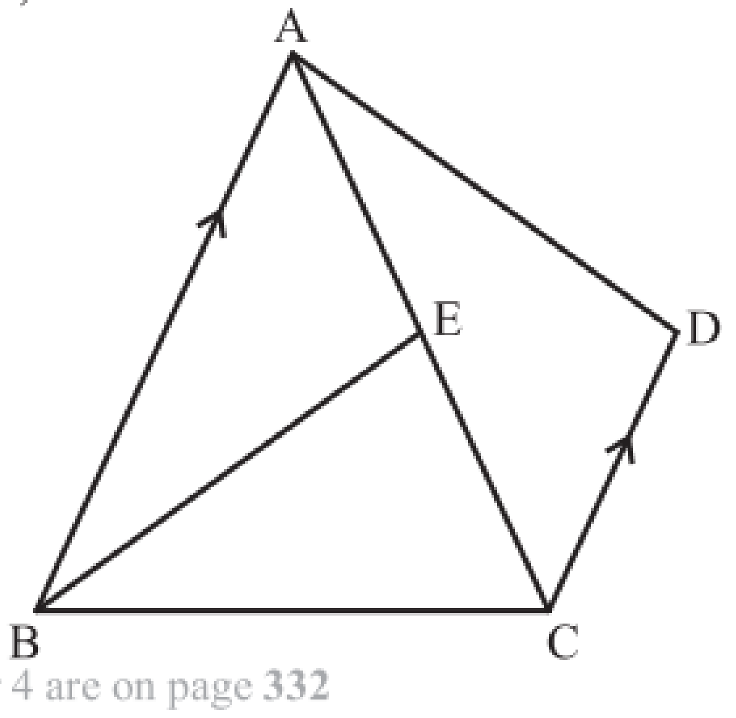
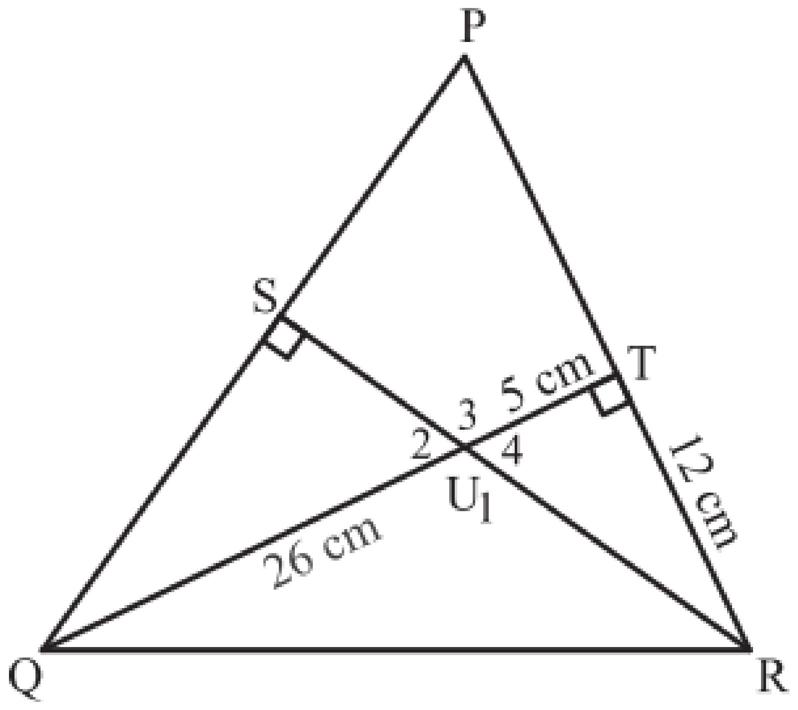
4) In the diagram below, AB//CD, AB = AC and AE = CD. Prove that BE = AD.



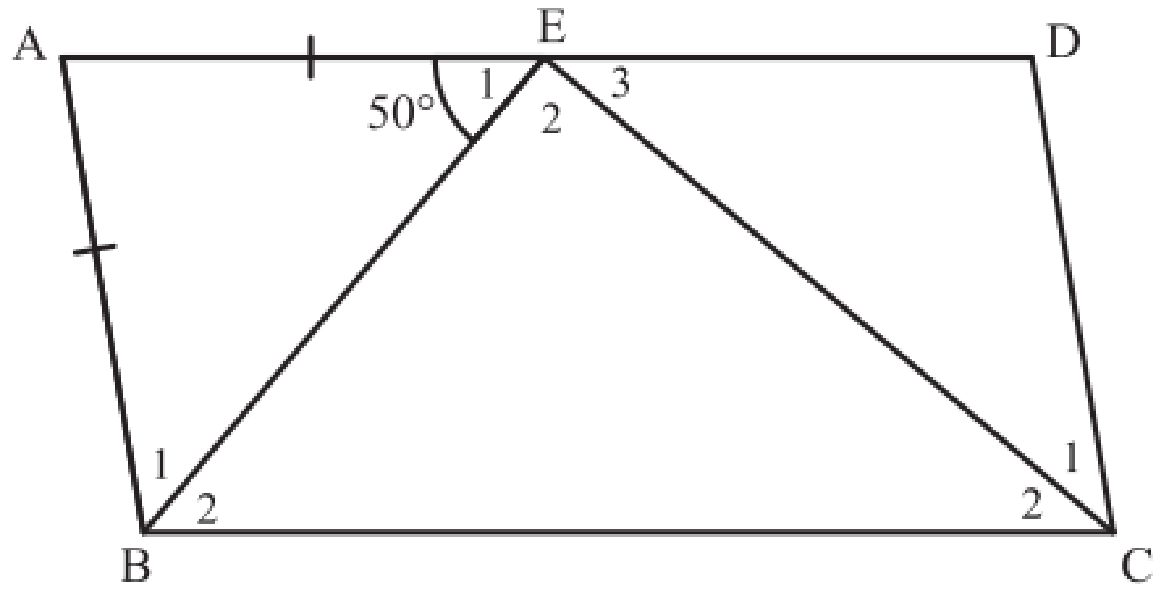
Solutions to the Mixed Exercise number 4 are on page **332**

5) In the diagram below, SR⊥PQ, TQ⊥PR, TU = 5cm, QU = 26cm and TR = 12cm.



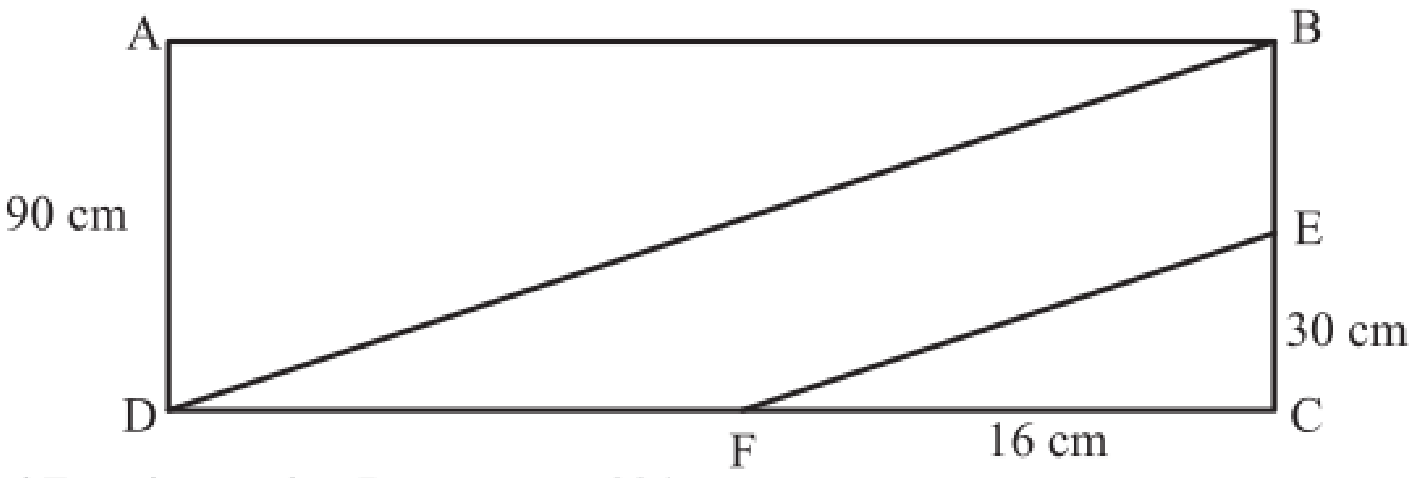
a) Determine the length of QR.
b) Prove that △SUQ///△TUR
c) Hence, determine the length of SQ.
Solutions to the Mixed Exercise number 5 are on page **333**

6) In the diagram below ABE is an isosceles triangle. EC bisects $B\hat{C}D$ and EB bisects $A\hat{B}C$.



a) Prove that AE//BC.
b) Complete the following sentence: Opposite angles of a parallelogram are _________
c) If ABCD is a parallelogram, determine the size of angle $\hat{C}_2$.
d) Hence, determine the size of angle $\hat{E}_2$.
e) If EB = 6 units and EC = 8 units, determine the length of BC.
Solutions to the Mixed Exercise number 6 are on page **333**

7) ABCD below is a rectangle and ΔBCD///ΔECF. EC = 30cm, CF = 16cm and AD = 90cm. Determine the length of DB.



Solutions to the Mixed Exercise number 7 are on page **334**

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Chapter 12 – Geometry of 2D Shapes (Solutions)

Exercise 1 Solutions:

1)

	Statement	Reason
a)	$x = 180^\circ - 49^\circ$ $= 131^\circ$ $y + 82^\circ = 131^\circ$ $\therefore y = 49^\circ$	co-int. ∠'s (BC//AD) ext ∠ of Δ
b)	$\hat{C} = 24^\circ$ $x + 24^\circ = 140^\circ$ $\therefore x = 116^\circ$	alt. ∠'s (AB//CD) ext ∠ of Δ
c)	$\hat{B} = \hat{D} = x$ $2x + 90^\circ = 180^\circ$ $\therefore x = 45^\circ$ $z = 45^\circ$ $y = 90^\circ + 45^\circ$ $= 135^\circ$	∠'s opp. = sides ∠'s in a Δ alt. ∠'s (AC//BD) ext. ∠ of Δ

	Statement	Reason
d)	$\hat{C} = 3x$ $3x + 2x + x = 180^\circ$ $\therefore 6x = 180^\circ$ $\therefore x = 30^\circ$	alt. ∠'s (AC//BD) ∠'s in a Δ
e)	$x = 49^\circ$ $\therefore x = y = 49^\circ$ $z = 180^\circ - 98^\circ$ $= 82^\circ$	adj. ∠'s on str. Line ∠'s opp. = sides ∠'s in a Δ
f)	$4x - 50^\circ = 2x - 10^\circ + x$ $\therefore x = 40^\circ$	ext. ∠ of Δ

Exercise 1 number 1 is on page **322**

2)

	Statement	Reason
a)	$AB^2 = 4^2 + 3^2$ $= 25$ $\therefore AB = 5\,cm$	Pythag.

	Statement	Reason
b)	$AB^2 = 17^2 - 8^2$ $= 225$ $\therefore AB = 15\,cm$	Pythag.

Exercise 1 number 2 is on page **322**

Exercise 2 Solutions:

1)

a) True
b) True
c) False
d) False
e) False
f) False

Exercise 2 number 1 is on page **322**

2)

	Statement	Reason
a)	$\hat{E}_1 = 130^\circ$ $\hat{A}_2 + y = 180^\circ - 130^\circ$ $= 50^\circ$ $\hat{A}_2 = y = 25^\circ$	vert. opp ∠'s ∠'s in a Δ ∠'s opp. = sides
b)	$\hat{D}_1 = y = 25^\circ$ $x = 90^\circ - 25^\circ$ $\therefore x = 65^\circ$	alt. ∠'s (AB//CD) AD⊥CD

	Statement	Reason
c)	$AC^2 = 12^2 + 5^2$ $= 169$ $\therefore AC = 13\,mm$ $\therefore BE = 7{,}5\,mm$	Pythag. diags. of a rect. = and bisect each other

Exercise 2 number 2 is on page **323**

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3)

Statement	Reason
$DE = BE = 24$	diags of a kite
$AE^2 = 25^2 - 24^2$	Pythag.
$= 49$	
$\therefore AE = 7\,cm$	
$EC^2 = 145^2 - 24^2$	Pythag.
$= 20\,449$	
$\therefore EC = 143\,cm$	
$\therefore AC = 7 + 143$	
$= 150\,cm$	

Exercise 2 number 3 is on page **323**

4)

a) For the frame to be a rectangle the corner angles must be 90°. Using Bens dimensions:
$20^2 + 25^2 = 1025$
$29^2 = 841$
$29^2 \neq 20^2 + 25^2$
$\therefore$ The corner angles cannot equal 90° as Pythagoras does not apply.

b) $20^2 + 21^2 = 841$
$29^2 = 841$
$29^2 = 20^2 + 21^2$
$\therefore$ Tuli is correct as Pythagoras applies and the corner angles will be equal to 90° making the frame a rectangle.

Exercise 2 number 4 is on page **323**

5)

a)

Statement	Reason
$\hat{B}_2 + \hat{B}_3 = 90^\circ$	Corner ∠'s of a rectangle = 90°
$\therefore 60^\circ + \hat{B}_3 = 90^\circ$	
$\therefore \hat{B}_3 = 30^\circ$	

b) The diagonals of a rhombus bisect each other at **90°** and the diagonals of a rectangle **bisect** each other.

c)

Statement	Reason
BG = GC = 2,5 cm $\therefore$ BC = 5cm	diags. of a rect. =
$\hat{E}_3 + \hat{E}_4 = 90^\circ$	diags. of a rhombus
$BE^2 = BC^2 - EC^2$	Pythag.
$= 5^2 - 3^2$	
$= 16$	
$\therefore BE = 4\,cm$	
$BE = ED = 4\,cm$	diags. of a rhombus
$\therefore BD = 8\,cm$	

Exercise 2 number 4 is on page **323**

<u>Exercise 3 Solutions</u>:

1)

a) △ABC///△QPR.

b) Not similar.

c) Not similar.

d) △ABC///△QRP.

Exercise 3 number 1 is on page **324**

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2)

	Statement	Reason
a)	In $\triangle CAB$ and $\triangle CDE$ $\hat{C}_1 = \hat{C}_2$ $\hat{A} = \hat{D}$ $\hat{B} = \hat{E}$ $\therefore \triangle CAB /// \triangle CDE$	 vert. opp. ∠'s alt. ∠'s (AB//DE) 3rd ∠ of △ **or** alt. ∠'s (AB//DE) A.A.A
b)	$\frac{CA}{CD} = \frac{AB}{DE} = \frac{CB}{CE}$ $\therefore \frac{CA}{4} = \frac{32}{8}$ $\therefore AC = 16$ units	sim. △'s

Exercise 3 number 2 is on page **324**

3)

	Statement	Reason
a)	In $\triangle ADE$ and $\triangle ABC$ $\frac{AD}{AB} = \frac{2}{4} = \frac{1}{2}$ $\frac{AE}{AC} = \frac{2{,}5}{5} = \frac{1}{2}$ $\frac{DE}{BC} = \frac{4}{8} = \frac{1}{2}$ $\therefore \triangle ADE /// \triangle ABC$	 sides in prop.
b)	$\hat{D}_1 = \hat{B} = 38^\circ$ $\therefore x = 38^\circ$ $y + x + 46^\circ = 180^\circ$ $\therefore y = 96^\circ$	sim. △'s ∠'s in a △

Exercise 3 number 3 is on page **324**

4)

Statement	Reason
In $\triangle ADE$ and $\triangle ABC$ $\hat{A} = \hat{A}$ $\hat{D} = \hat{B}$ $\hat{E} = \hat{C}$ $\therefore \triangle ADE /// \triangle ABC$ $\therefore \frac{AE}{AC} = \frac{DE}{BC}$ $\therefore \frac{2-x}{2} = \frac{2}{3}$ $\therefore 2 - x = \frac{4}{3}$ $\therefore -x = -\frac{2}{3}$ $\therefore x = \frac{2}{3}$ cm	 common ∠ corr. ∠'s (DE//BC) 3rd ∠ of △ **or** corr. ∠'s (DE//BC) A.A.A sim. △'s

Exercise 3 number 4 is on page **324**

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Exercise 4 Solutions:

1)

a) $\triangle ABC \equiv \triangle EDC$ (A.A.S)
b) $\triangle ABC \equiv \triangle DEF$ (A.A.S)
c) Not congruent
d) $\triangle COD \equiv \triangle AOB$ (S.A.S)
e) $\triangle ABD \equiv \triangle ACD$ (R.H.S)
f) $\triangle ABD \equiv \triangle ACD$ (S.A.S)
g) Not congruent
h) $\triangle ABD \equiv \triangle ACD$ (S.S.S)
i) Not congruent

Exercise 4 number 1 is on page **325**

2) BF = BE + EF and CE = CF + EF. However, BE = CF. Therefore, BF = CE.

Statement	**Reason**
In $\triangle AFB$ and $\triangle DEC$	
$\hat{B} = \hat{C} = 90^\circ$	given
AF = DE	given
BF = CE	proved above
$\therefore \triangle ADE \equiv \triangle ABC$	R.H.S

Exercise 4 number 2 is on page **325**

3)

	Statement	**Reason**
a)	In $\triangle ABE$ and $\triangle ADG$	
	$\hat{B} = \hat{D} = 90^\circ$	given (ABCD is a square)
	AB = AD	given (ABCD is a square)
	BE = DG	given
	$\therefore \triangle ABE \equiv \triangle ADG$	S.A.S
	$\therefore$ AE = AG	congruent $\triangle$'s
b)	In $\triangle AEF$ and $\triangle AGF$	
	AE = AG	congruent $\triangle$'s (proved above)
	$\hat{F}_1 = \hat{F}_2 = 90^\circ$	Given
	AF = AF	common side
	$\therefore \triangle AEF \equiv \triangle AGF$	S.A.S

Exercise 4 number 3 is on page **325**

4) As ABCD is a trapezium AD//BC.

	Statement	**Reason**
a)	In $\triangle ABD$ and $\triangle ECB$	
	$\hat{A} = \hat{E}_2$	given
	$\hat{D}_1 = \hat{B}_2$	alt. $\angle$'s (AD//BC)
	BD = BC	given (DBC is an isosceles $\triangle$)
	$\therefore \triangle ABD \equiv \triangle ECB$	A.A.S
b)	$\hat{E}_2 = 116^\circ$	adj. $\angle$'s on a str. line
	$\hat{B}_2 = 34^\circ$	given
	$\hat{C}_1 = 30^\circ$	$\angle$'s in a $\triangle$
	$\therefore \hat{B}_1 = 30^\circ$	congruent $\triangle$'s

Exercise 4 number 4 is on page **326**

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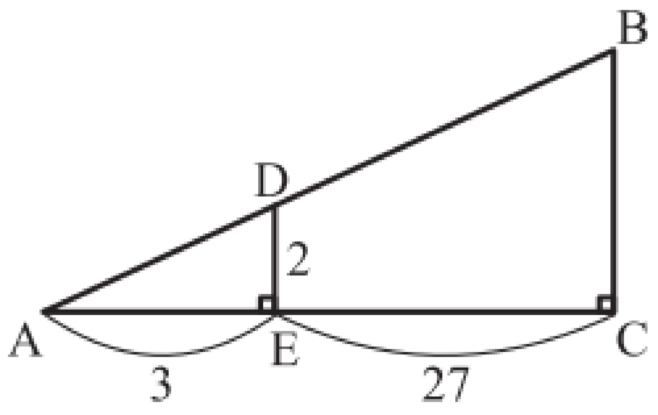
Mixed Exercise Solutions:

1)

a) Similar triangles.

b)

Statement	Reason
In $\triangle AED$ and $\triangle ACB$	
$\hat{A} = \hat{A}$	common $\angle$
$\hat{E} = \hat{C}$	given
$\hat{D} = \hat{B}$	3rd $\angle$ of $\triangle$
$\therefore \triangle AED /// \triangle ACB$	A.A.A
$\therefore \frac{BC}{DE} = \frac{AC}{AE}$	sim. $\triangle$'s
$\therefore \frac{BC}{2} = \frac{30}{3}$	
$\therefore BC = 20$ metres	



The Mixed Exercise number 1 is on page **326**

2)

Statement	Reason
In $\triangle PRQ$ and $\triangle PSQ$	
$PR = PS$	radii
$RQ = SQ$	radii
$PQ = PQ$	common side
$\therefore \triangle PRQ \equiv \triangle PSQ$	S.S.S

The Mixed Exercise number 2 is on page **326**

3)

Statement	Reason
$\hat{C}_2 = 180° - \hat{C}_1$	adj. $\angle$'s on a str. line
$\hat{D}_2 = 180° - \hat{D}_1$	adj. $\angle$'s on a str. line
$\hat{C}_1 = \hat{D}_1$	given
$\therefore \hat{C}_2 = \hat{D}_2$	
In $\triangle ABC$ and $\triangle AED$	
$BC = ED$	given
$\hat{C}_2 = \hat{D}_2$	proved above
$AC = AD$	$\angle$'s opp. = sides
$\therefore \triangle ABC \equiv \triangle AED$	S.A.S
$\therefore AB = AE$	congruent $\triangle$'s

The Mixed Exercise number 3 is on page **326**

4)

Statement	Reason
In $\triangle BAE$ and $\triangle ACD$	
$BA = AC$	given
$\hat{A} = \hat{C}$	alt. $\angle$'s
$AE = CD$	given
$\therefore \triangle BAE \equiv \triangle ACD$	S.A.S
$\therefore BE = AD$	congruent $\triangle$'s

The Mixed Exercise number 4 is on page **327**

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5)

	Statement	Reason
a)	$QR^2 = QT^2 + TR^2$ $= 31^2 + 12^2$ $= 1105$ $\therefore QR = \sqrt{1105}$ $= 33,24\,cm$	Pythag.
b)	In $\triangle SUQ$ and $\triangle TUR$ $\hat{S} = \hat{T} = 90^\circ$ $\hat{U}_2 = \hat{U}_4$ $\hat{Q} = \hat{R}$ $\triangle SUQ /// \triangle TUR$	 given vert. opp $\angle$'s 3rd $\angle$ of $\triangle$ A.A.A
c)	$UR^2 = 5^2 + 12^2$ $= 169$ $\therefore UR = 13\,cm$ $\frac{SQ}{TR} = \frac{UQ}{UR}$ $\therefore \frac{SQ}{12} = \frac{26}{13}$ $\therefore SQ = 24\,cm$	Pythag. sim. $\triangle$'s

The Mixed Exercise number 5 is on page **327**

6)

	Statement	Reason
a)	$\hat{B}_1 = \hat{E}_1 = 50^\circ$ $\hat{B}_1 = \hat{B}_2 = 50^\circ$ $\therefore \hat{B}_2 = \hat{E}_1$ $\therefore AE // BC$	$\angle$'s opp. = sides given (EC bisects $A\hat{B}C$) alt. $\angle$'s are =

b) Opposite angles of a parallelogram are **equal**.

	Statement	Reason
c)	$\hat{A} = 80^\circ$ $\hat{C} = 80^\circ$ $\therefore \hat{C}_2 = 40^\circ$	$\angle$'s in a $\triangle$ opp. $\angle$'s of a parm = given (EB bisects $B\hat{C}D$)
d)	$\hat{E}_3 = 40^\circ$ $\hat{E}_2 = 180^\circ - 50^\circ - 40^\circ$ $= 90^\circ$	alt. $\angle$'s (ED//BC) adj. $\angle$'s on a str. line
e)	$BC^2 = EB^2 + EC^2$ $= 6^2 + 8^2$ $= 100$ $\therefore BC = 10\,units$	Pythag.

The Mixed Exercise number 6 is on page **327**

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7)

Statement	Reason
BC = AD = 90cm	opp. sides of a rect.
$\hat{C} = 90^\circ$	corner ∠'s of a rect.
$EF^2 = 16^2 + 30^2$	Pythag.
$= 1156$	
$\therefore EF = 34\,cm$	
$\frac{DB}{EF} = \frac{BC}{EC}$	sim. Δ's
$\therefore \frac{DB}{34} = \frac{90}{30}$	
$\therefore DB = 102\,cm$	

The Mixed Exercise number 7 is on page **327**

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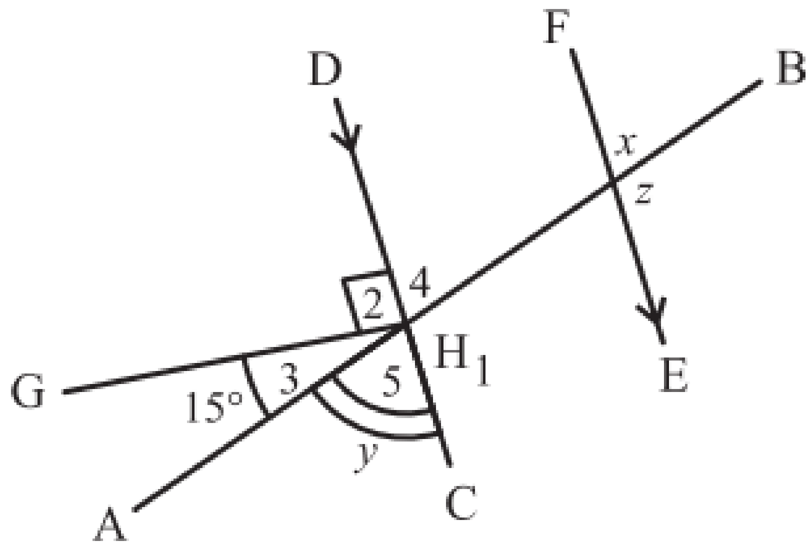
Chapter 13 – Geometry of Straight Lines

Geometry of Straight Lines (from pages 141- 145)

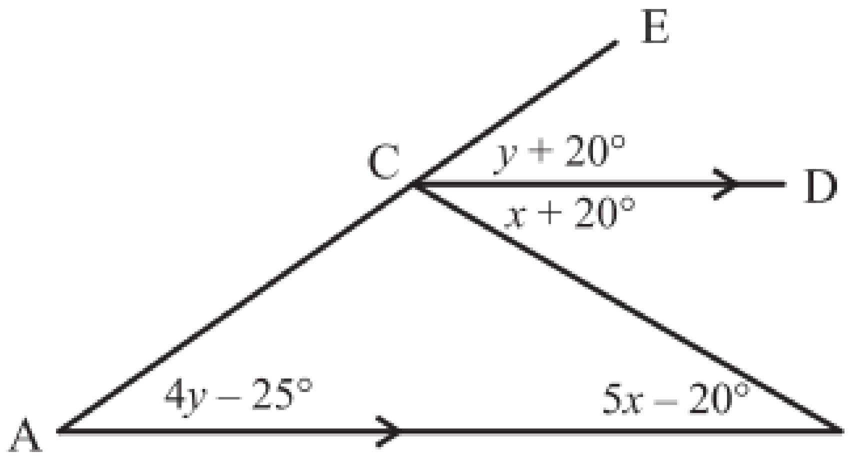
Mixed Exercise

1) Determine the values of x, y and z in the diagrams below. Remember to state all reasons for your answers.

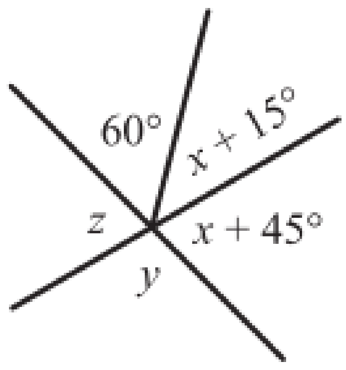
a)



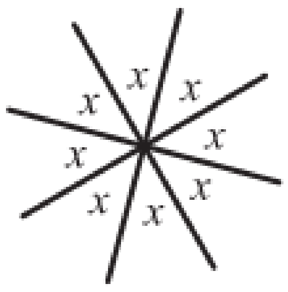
d)



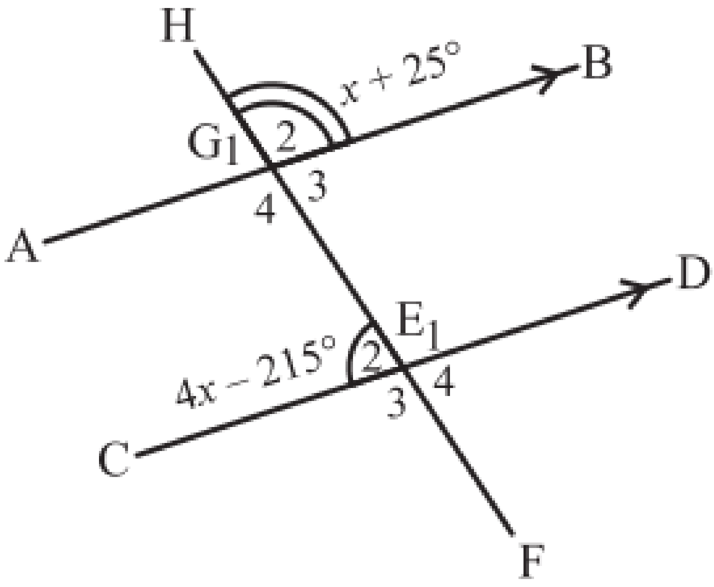
b)



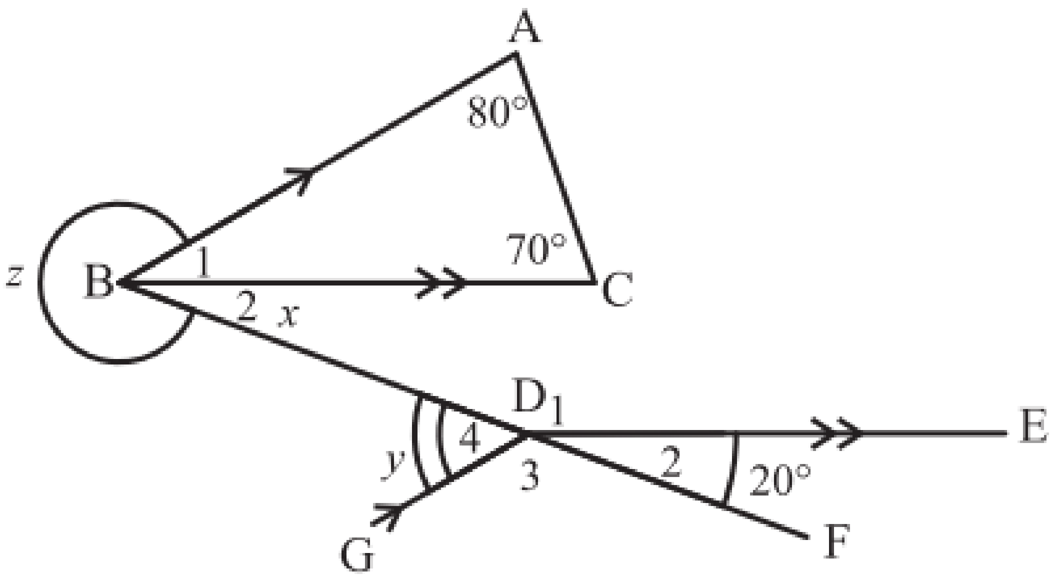
e)



c)

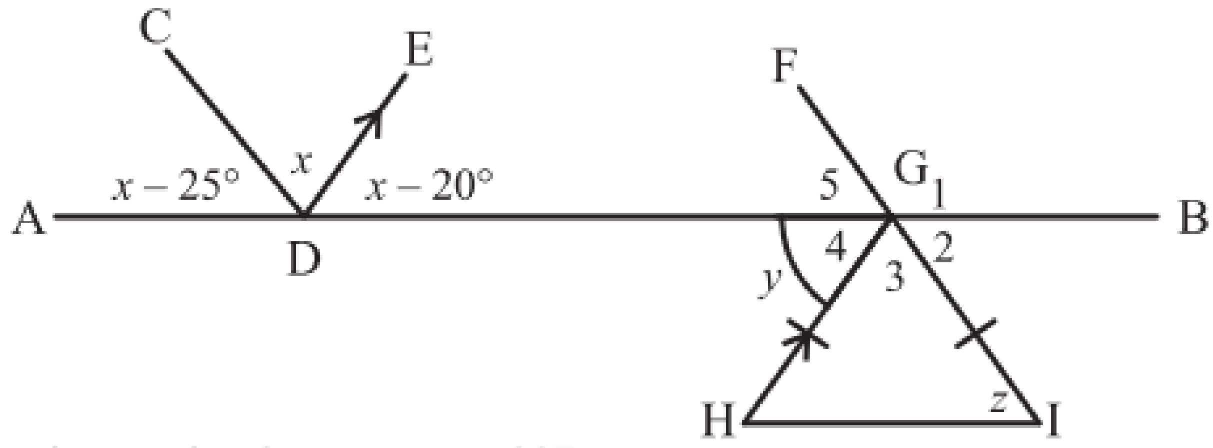


f)



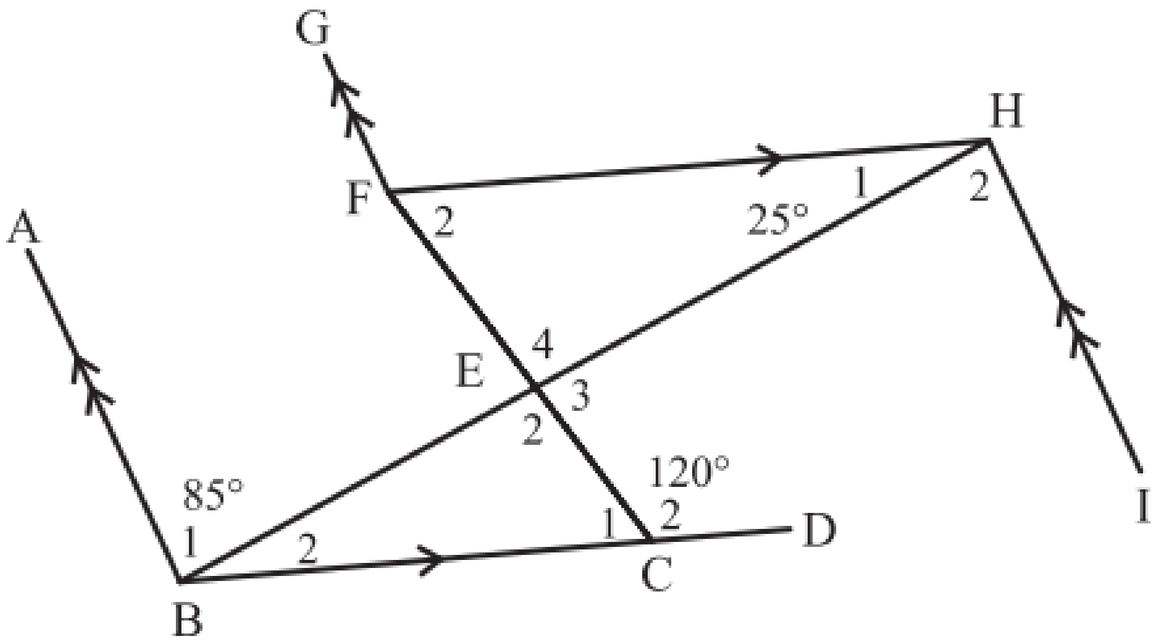
Solutions to the Mixed Exercise number 1 are on page 337

2) In the figure below ED//GH, CD//FI and GH = GI. Calculate the value of x, y and z.



Solutions to the Mixed Exercise number 2 are on page 337

3) In the diagram alongside AB//GF//HI and BC//FH.



a) Calculate the value of $B\hat{H}I$.

b) Calculate the value of $\hat{B}_2$.

c) Calculate the value of $\hat{C}_1$.

d) Calculate the value of $\hat{F}_1$.

e) Calculate the value of $\hat{F}_2$.

Solutions to the Mixed Exercise number 3 are on page 338

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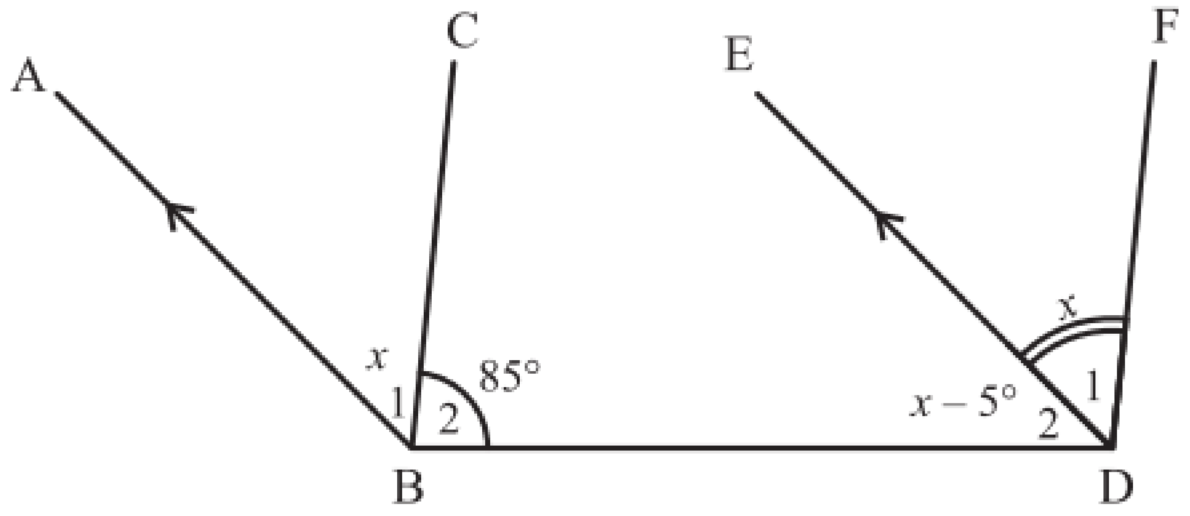
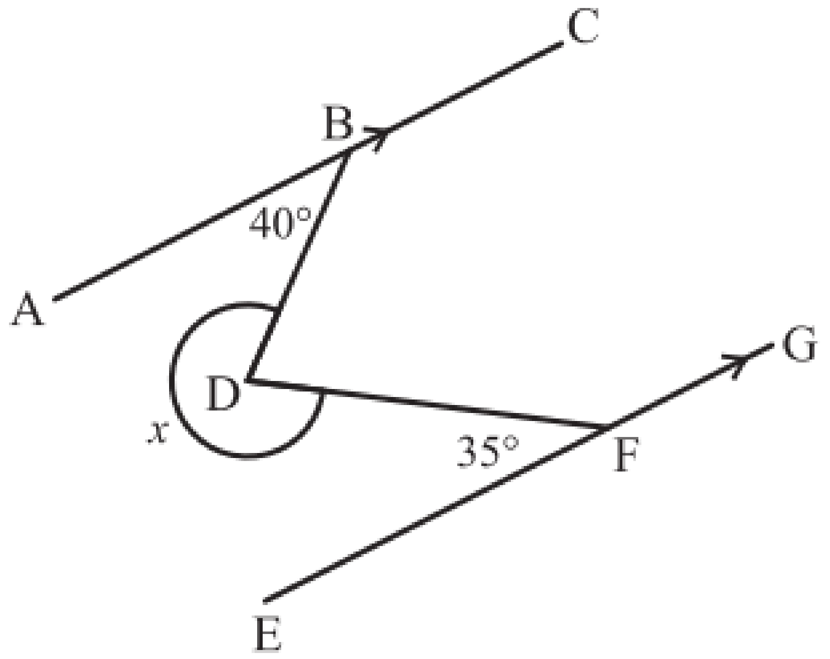
4) In the figure below AB// ED. Prove that CB//DF.



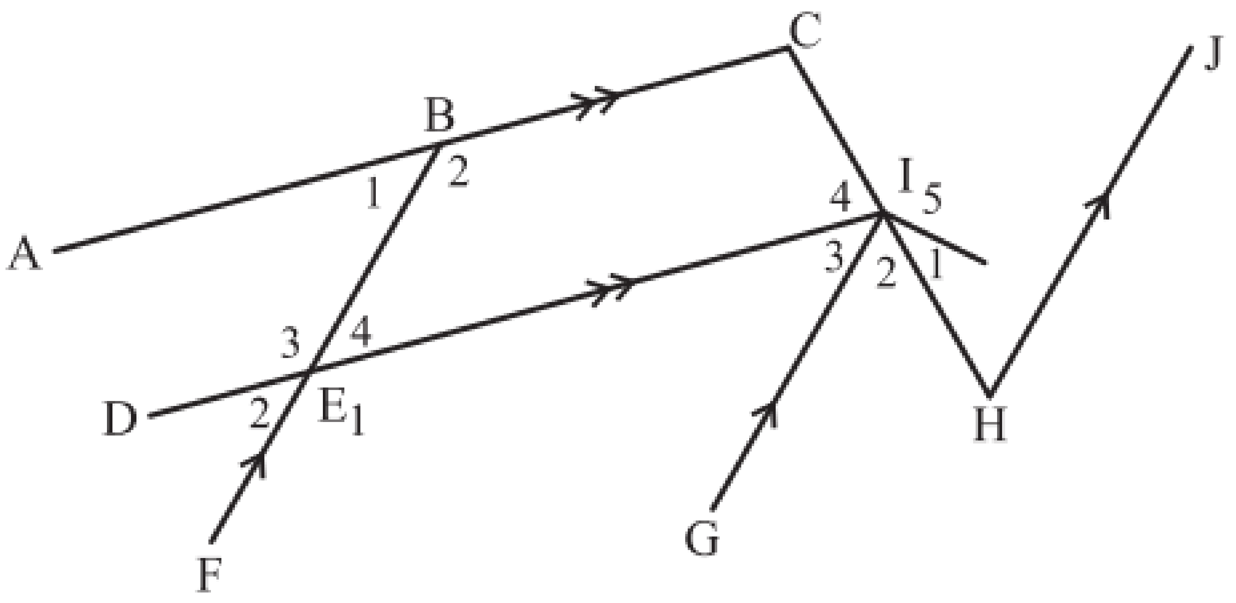
Solutions to the Mixed Exercise number 4 are on page **338**

5) By drawing in an additional parallel line, calculate the size of angle *x*.



Solutions to the Mixed Exercise number 5 are on page **338**

6) Examine the diagram below:



Classify each pair of the given angles as one of the following:

1. **Alternate Angles**
2. **Corresponding Angles**
3. **Co-interior angles**
4. **Vertically opposite angles**
5. **None of the above.**

a) $\hat{B}_1$ and $B\hat{C}H$

b) $\hat{B}_1$ and $\hat{E}_4$

c) $\hat{E}_1$ and $\hat{E}_4$

d) $\hat{E}_2$ and $\hat{E}_4$

e) $\hat{E}_1$ and $\hat{I}_4$

f) $\hat{E}_3$ and $\hat{B}_1$

g) $\hat{E}_2$ and $\hat{I}_3$

h) $\hat{I}_2$ and $I\hat{H}J$

i) $\hat{I}_1$ and $\hat{I}_4$

j) $\hat{I}_5$ and $\hat{I}_3$

k) $\hat{B}_2$ and $\hat{E}_4$

l) $\hat{B}_2$ and $B\hat{C}H$

Solutions to the Mixed Exercise number 6 are on page **338**

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Chapter 13 – Geometry of Straight Lines (Solutions)

Mixed Exercise Solutions:

1)

	Statement	Reason
a)	$\hat{D}_4 = 75^\circ$	adj. ∠'s on a str. line
	$x = \hat{D}_4 = 75^\circ$	corr. ∠'s (DC//FE)
	$y = \hat{D}_4 = 75^\circ$	vert. opp. ∠'s
	$z = 180^\circ - x = 105^\circ$	adj. ∠'s on a str. line
b)	$120^\circ + 2x = 180^\circ$	adj. ∠'s on a str. line
	$\therefore 2x = 60^\circ$	
	$\therefore x = 30^\circ$	
	$y = 60^\circ + x + 15^\circ$	vert. opp. ∠'s
	$= 105^\circ$	
	$z = x + 45$	vert. opp. ∠'s
	$= 75^\circ$	
c)	$\hat{E}_1 = 180^\circ - \left(4x - 215^\circ\right)$	adj. ∠'s on a str. line
	$= 395^\circ - 4x$	
	$\hat{G}_2 = \hat{E}_1$	corr. ∠'s (GB//ED)
	$\therefore x + 25^\circ = 395^\circ - 4x$	
	$\therefore 5x = 370^\circ$	
	$\therefore x = 74^\circ$	

	Statement	Reason
d)	$5x - 20^\circ = x + 20^\circ$	alt. ∠'s (CD//AB)
	$\therefore 4x = 40^\circ$	
	$\therefore x = 10^\circ$	
	$4y - 25^\circ = y + 20^\circ$	corr. ∠'s (CD//AB)
	$\therefore 3y = 45^\circ$	
	$\therefore y = 15^\circ$	
e)	$8x = 360^\circ$	∠'s around a pt.
	$\therefore x = 45^\circ$	
f)	$x = 20^\circ$	corr. ∠'s (BC//ED)
	$\hat{B}_1 = 30^\circ$	∠'s in a Δ
	$y = \hat{B}_1 + x$	alt. ∠'s (AB//DG)
	$= 30^\circ + 20^\circ$	
	$= 50^\circ$	
	$z = 360^\circ - \hat{B}_1 - x$	∠'s around a pt.
	$= 310^\circ$	

The Mixed Exercise number 1 is on page **335**

2)

Statement	Reason
$x - 25^\circ + x + x - 20^\circ = 180^\circ$	adj. ∠'s on a str. line
$\therefore 3x = 225^\circ$	
$\therefore x = 75^\circ$	
$y = x - 20^\circ$	alt. ∠'s (ED//GH)
$= 55^\circ$	
$\hat{G}_3 + y = x + x - 20^\circ$	alt. ∠'s (CD//GI)
$\therefore \hat{G}_3 = 75^\circ + 75^\circ - 20^\circ - 55^\circ$	
$= 75^\circ$	
$\hat{H} = \hat{I} = z$	∠'s opp. = sides
$\hat{H} + \hat{I} + \hat{G}_3 = 180^\circ$	∠'s in a Δ
$\therefore 2z = 180^\circ - 75^\circ$	
$\therefore z = 52{,}5^\circ$	

The Mixed Exercise number 2 is on page **335**

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3)

a)	$B\hat{H}I = 85^\circ$	alt. ∠'s (AB//HI)
b)	$\hat{B}_2 = 25^\circ$	alt. ∠'s (FH//BD)
c)	$\hat{C}_1 = 60^\circ$	adj. ∠'s on a str. line
d)	$\hat{F}_1 = \hat{H}_1 + \hat{H}_2 = 25^\circ + 85^\circ = 110^\circ$	alt. ∠'s (FG//HI)
e)	$\hat{F}_2 = \hat{C}_1 = 60^\circ$	alt. ∠'s (FH//BD)

The Mixed Exercise number 3 is on page **335**

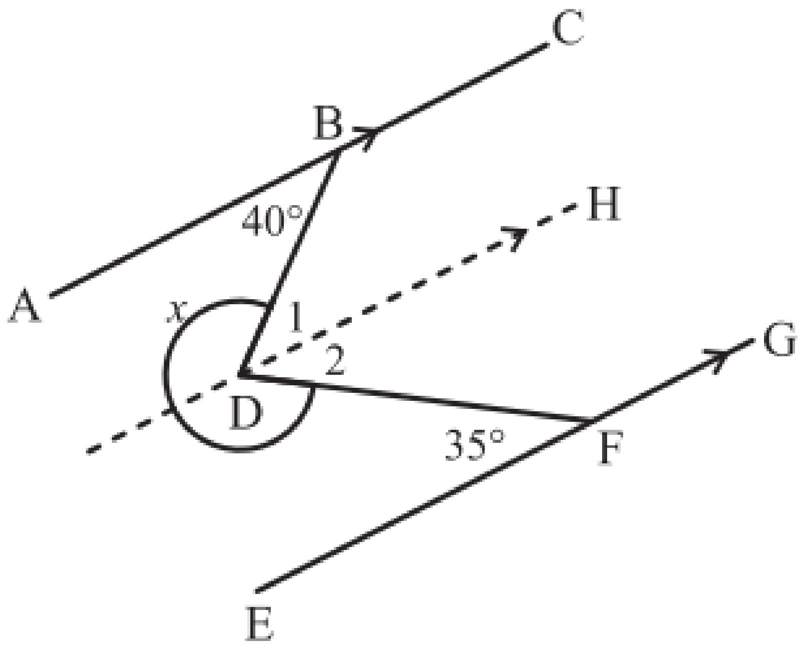
4)

Statement	Reason
$x + 85^\circ + x - 5^\circ = 180^\circ$	co-int. ∠'s (AB//ED)
$\therefore 2x = 100^\circ$ $\therefore x = 50^\circ$ $\hat{D}_1 + \hat{D}_2 = 50^\circ - 5^\circ + 50^\circ$ $= 95^\circ$ $\therefore \hat{B}_2 + \hat{D}_1 + \hat{D}_2 = 180^\circ$ $\therefore$ CB//FD	co-int. ∠'s are supplementary (add up to 180°)

The Mixed Exercise number 4 is on page **336**

5)

Statement	Reason
$\hat{D}_1 = 40^\circ$	alt. ∠'s (AC//DH)
$\hat{D}_2 = 35^\circ$	alt. ∠'s (EG//DH)
$x + \hat{D}_1 + \hat{D}_2 = 360^\circ$	∠'s around a pt.
$\therefore x = 360^\circ - 40^\circ - 35^\circ$	
$= 285^\circ$	



The Mixed Exercise number 5 is on page **336**

6)

a) None
b) Alternate angles
c) None
d) Vertically opposite
e) None
f) Co-interior angles
g) Corresponding angles
h) Alternate angles
i) None
j) None
k) Co-interior angles
l) None

The Mixed Exercise number 6 is on page **336**

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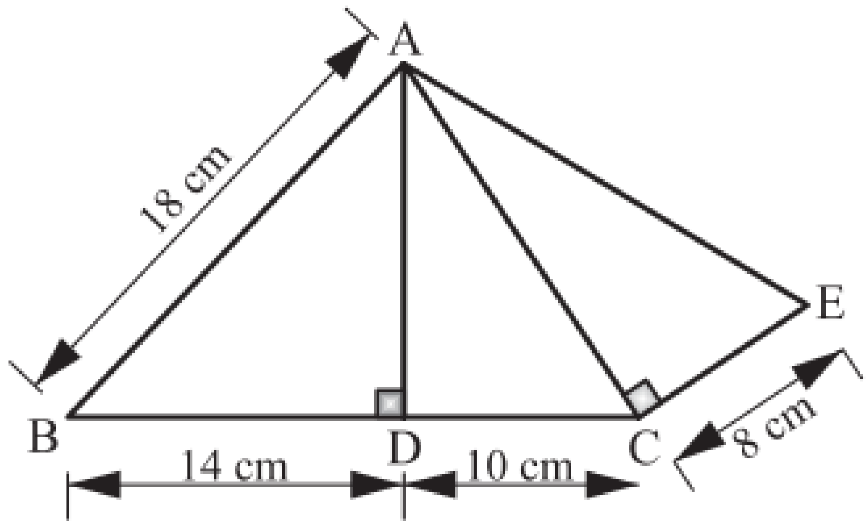
Chapter 14 – The Theorem of Pythagoras

Mixed Exercise (from pages 147- 149)

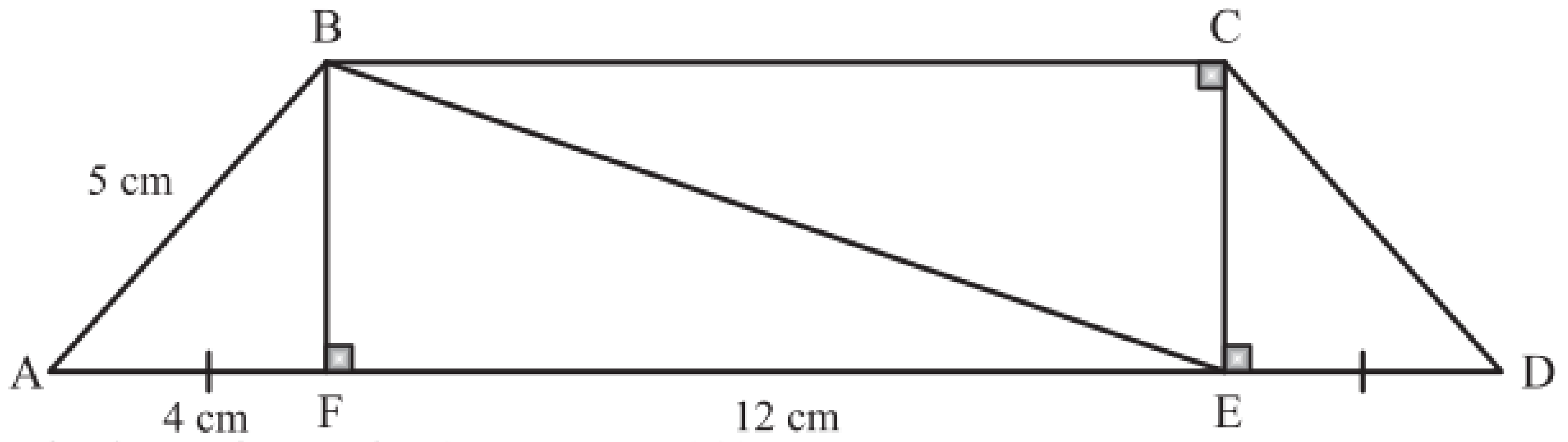
Mixed Exercise

1) Determine the length of AE in the diagram below. Give your answer correct to 1 decimal place.



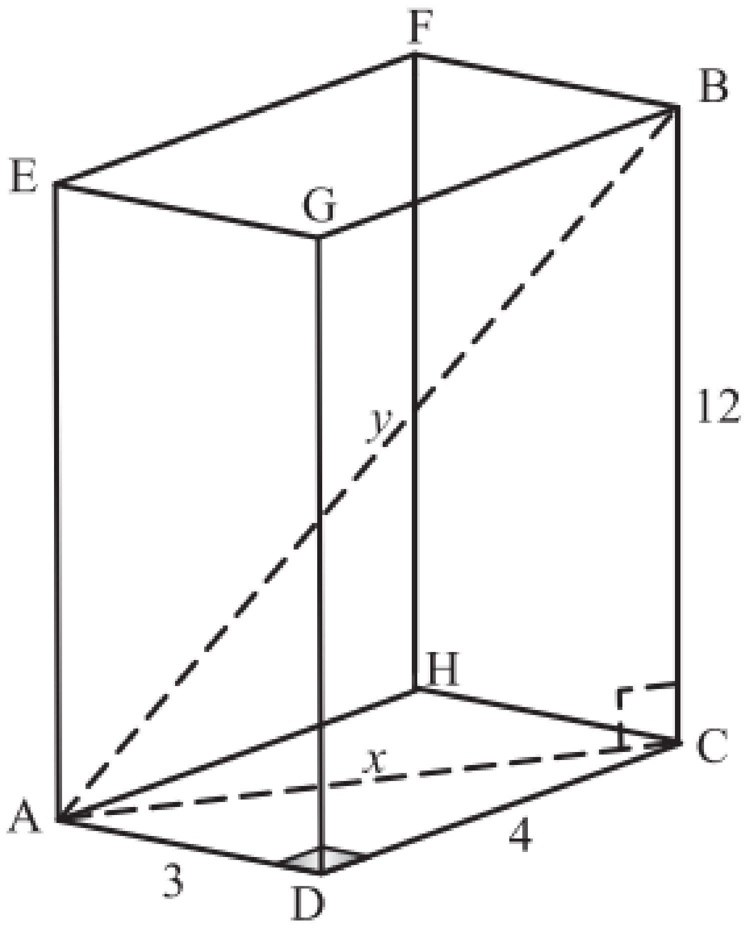
Solutions to the Mixed Exercise number 1 are on page 341

2) In the figure below AB = 5cm, AF = 4cm and AF = ED. Show that ΔABF ≡ ΔDCE.



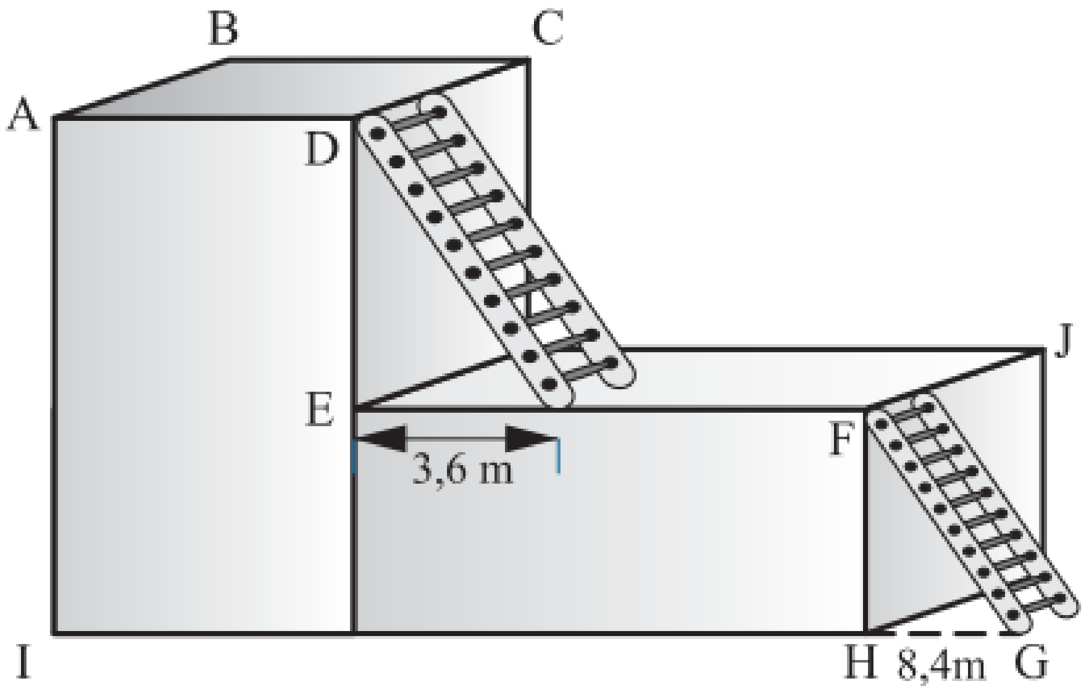
Solutions to the Mixed Exercise number 2 are on page 341

3) Determine the length of *x* and *y*. The dimensions of the figure are as shown on the diagram.



Solutions to the Mixed Exercise number 3 are on page 341

4) Joe needs to climb to the top of a ledge ABCD. He uses a ladder which is 8,5m long. To get to the top of the first ledge he places the ladder 8,4 meters from its base and climbs up. He then uses the same ladder to climb to the top of ledge ABCD. This time he places the ladder 3,6m from the base of the ledge. How high above the ground is ledge ABCD?



Solutions to the Mixed Exercise number 4 are on page 342

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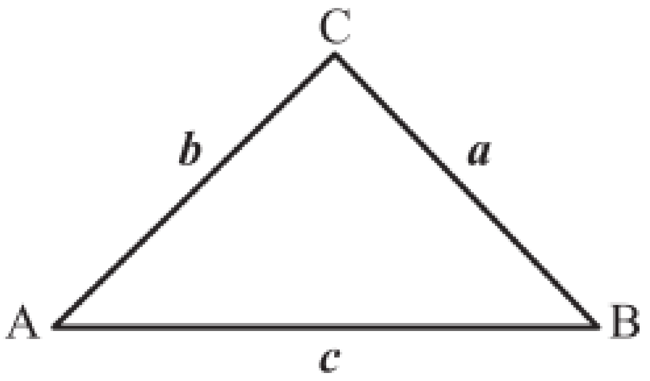
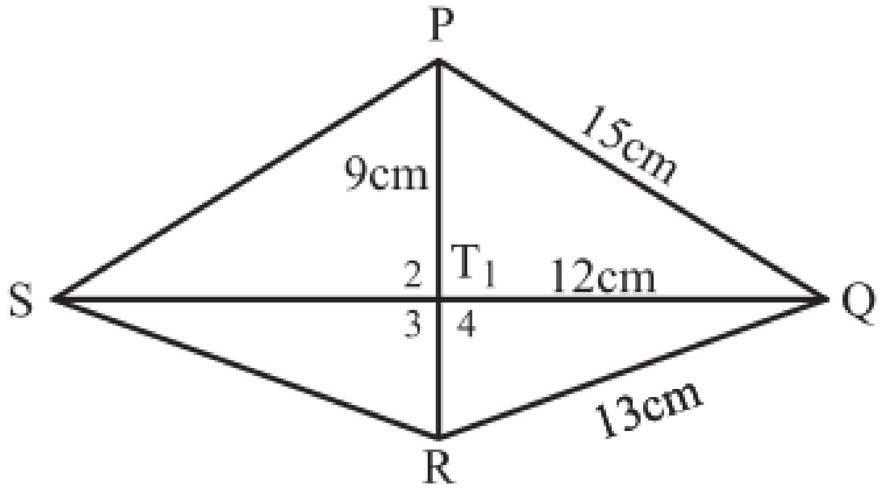
5) In the diagram below, c is the longest side. The table below shows how to classify triangles: Use the information in the diagram and table below to answer the questions which follow.



Relation of Sides	Type of Triangles
$c^2 < a^2 + b^2$	**Acute angled triangle**
$c^2 = a^2 + b^2$	**Right angled triangle at $\hat{C}$.**
$c^2 > a^2 + b^2$	**Obtuse angled triangle**

a) In quadrilateral PQRS below, what type of triangle is PTQ? If it is right angled, state which of the angles is a right angle.



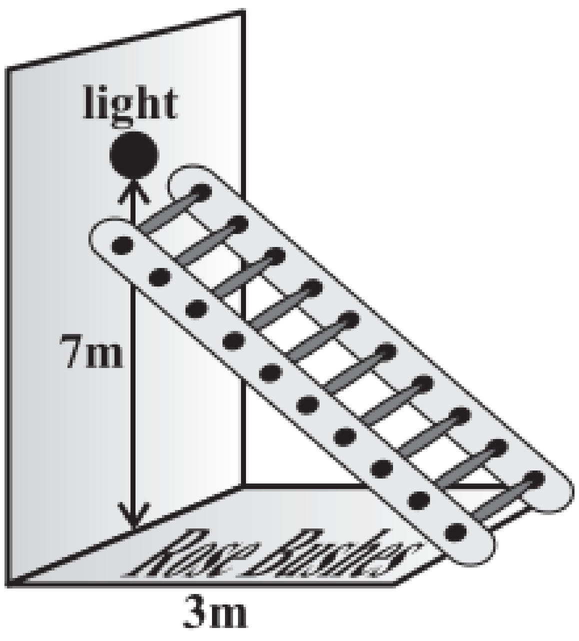
b) Write down the size of $\hat{T}_4$. You do not need to give a reason for your answer.

c) Determine the length of TR.

d) What type of triangle is ΔPQR? Give a reason for your answer.

Solutions to the Mixed Exercise number 5 are on page **342**

6) Mrs. Flower would like to replace an old inefficient flood light with a modern LED flood light which will use less electricity. She hires Ellie the electrician for this task. Underneath the flood light are Mrs. Flower's prize winning rose bushes. These bushes extend 3 metres out from the wall below the light. Ellie has a ladder which is 8 metres long and the flood light is 7 metres above the ground. If Ellie cannot place the base of his ladder in Mrs. Flower's rose bushes, does he have a ladder long enough to complete the task?



Solutions to the Mixed Exercise number 6 are on page **342**

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Chapter 14 – The Theorem of Pythagoras (Solutions)

Mixed Exercise Solutions:

1) $AD^2 = AB^2 - BD^2 \rightarrow$ Pythag

$= 18^2 - 14^2$

$= 128$

$\therefore AD = 8\sqrt{2}$ cm $\rightarrow$ leave the answer in surd form (it makes it easier for the next step)

$AC^2 = AD^2 + DC^2 \rightarrow$ Pythag

$= \left(8\sqrt{2}\right)^2 + 10^2$

$= 228$

$\therefore AC = 2\sqrt{57}$ cm $\rightarrow$ leave the answer in surd form (it makes it easier for the next step)

$AE^2 = AC^2 + CE^2 \rightarrow$ Pythag

$= \left(2\sqrt{57}\right)^2 + 8^2$

$= 292$

$\therefore AE = 17{,}1$ cm $\rightarrow$ the question said round off to 1 decimal place

The Mixed Exercise number 1 is on page **339**

2)

Statement	**Reason**
$BF^2 = AB^2 - AF^2$ $= 5^2 - 4^2$ $= 9$ $\therefore BF = 3$ cm $BF = CE$	Pythag.
$CD^2 = CE^2 + ED^2$ $= 3^2 + 4^2$ $= 25$ $\therefore CD = 5$ cm	Pythag.
In ΔABF and ΔDCE	
AB = CD = 5cm AF = ED = 4cm BF = CE = 3cm	proved above given proved above
$\therefore \Delta ABF \equiv \Delta DCE$	S.S.S

The Mixed Exercise number 2 is on page **339**

3) $AC^2 = AD^2 + CD^2 \rightarrow$ Pythag

$x^2 = 3^2 + 4^2 \rightarrow$ Pythag

$= 25$

$\therefore x = 5$ units

$AB^2 = BC^2 + AC^2 \rightarrow$ Pythag

$y^2 = 12^2 + 5^2$

$= 169$

$\therefore y = 13$ units

The Mixed Exercise number 3 is on page **339**

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4) $FH^2 = FG^2 - GH^2 \rightarrow$ Pythag

$= 8,5^2 - 8,4^2 \rightarrow$ Pythag

$= 1,69$

$\therefore FH = 1,3\,m$

$DE^2 = DK^2 - GK^2 \rightarrow$ Pythag

$= 8,5^2 - 3,6^2$

$= 59,29$

$\therefore DE = 7,7\,m$

$\therefore$ Height of the ledge $= 7,7 + 1,3$

$= 9\,m$

The Mixed Exercise number 4 is on page **339**

5)

a) $PQ^2 = 225$

$PT^2 + TQ^2 = 9^2 + 12^2$

$= 225$

$\therefore PQ^2 = PT^2 + TQ^2$

$\therefore \Delta PTQ$ is right angled at T_1. $\rightarrow$ the right angle is always opposite the longest side (the hypotenuse)

b) 90°.

c) $TR^2 = QR^2 - QT^2 \rightarrow$ Pythag

$= 13^2 - 12^2 \rightarrow$ Pythag

$= 25$

$\therefore TR = 5\,cm$

d) $PR = 9 + 5$

$= 14\,cm$

$\therefore$ PQ is the longest side

$PQ^2 = 225$

$PR^2 + QR^2 = 14^2 + 13^2$

$= 365$

$\therefore PQ^2 < PR^2 + QR^2$

$\therefore \Delta PQR$ is an acute angled triangled.

The Mixed Exercise number 5 is on page **340**

6) First calculate the length the minimum length of the ladder can be to reach the light:

Ladder length$^2 = 3^2 + 7^2$

$= 58$

$\therefore$ Ladder length $= 7,62\,m$

$\therefore$ Ellie's ladder is long enough as he only needs a ladder 7,62 m long and his is 8 m.

The Mixed Exercise number 6 is on page **340**

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Chapter 15 – Area and Perimeter

Area and Perimeter (from pages 151 - 153)

Exercise 1:

1) Answer the following questions:

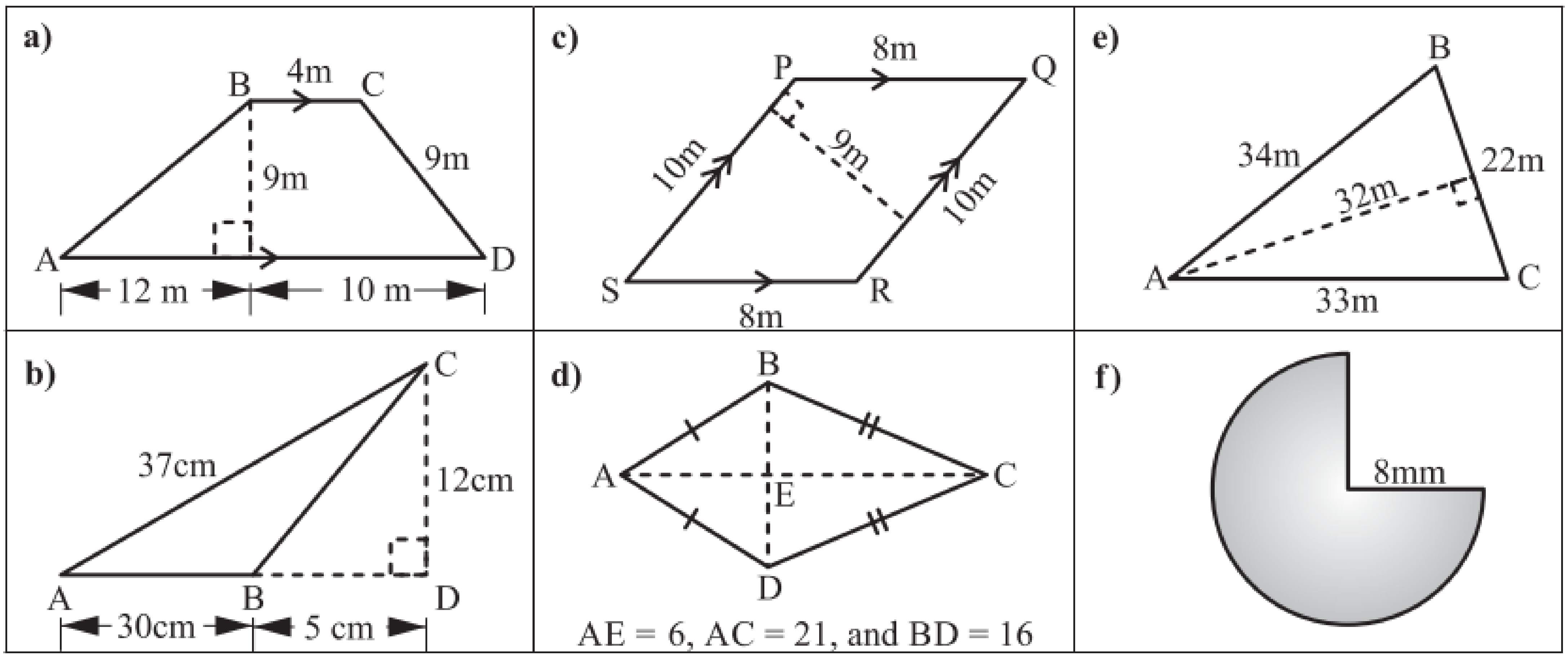
a) If the perimeter of a square is 32 cm, what is the length of each side?

b) If the area of a rectangle is 200 cm^2 and its length is 500 mm, what is its width?

c) If the base of a triangle is 2m and its perpendicular height is 200cm, what is the area of the triangle?

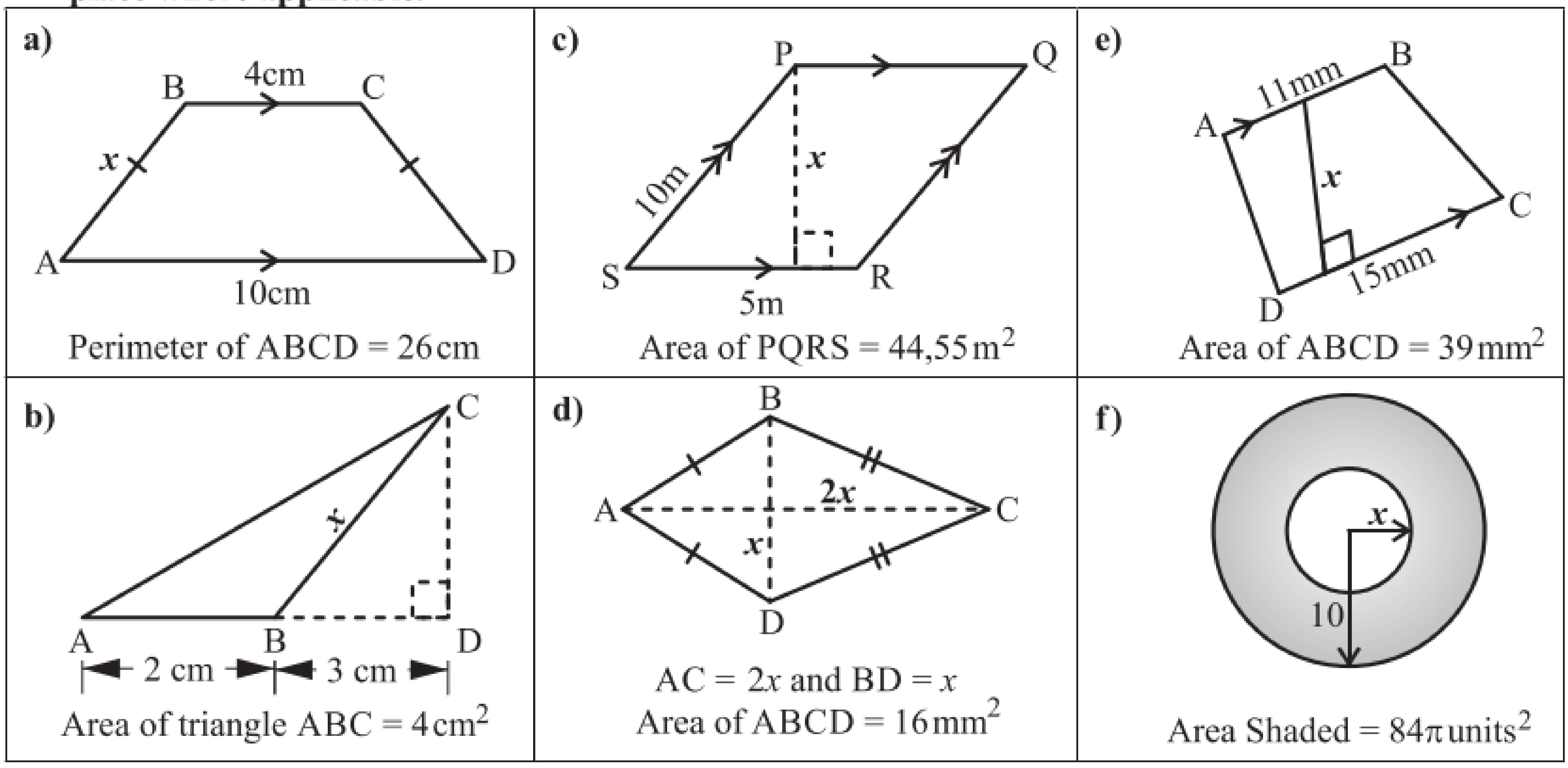
Solutions to Exercise 1 number 1 are on page 346

2) Calculate the area and perimeter of the shapes below. Round answers to 1 decimal place where applicable. (Remember that diagrams are not drawn to scale).



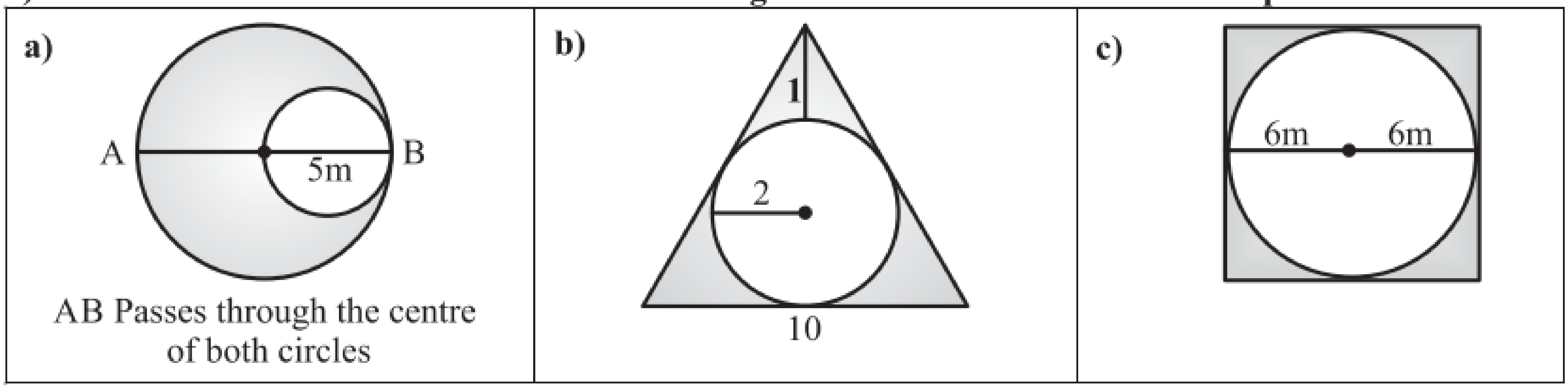
Solutions to Exercise 1 number 2 are on page 346

3) Using the information given in each diagram, determine the value of *x*. Round answers to 1 decimal place where applicable.



Solutions to Exercise 1 number 3 are on page 346

4) Determine the shaded area in each of the diagrams below correct to 1 decimal place.



Solutions to Exercise 1 number 4 are on page 346 questions are continued on the next page

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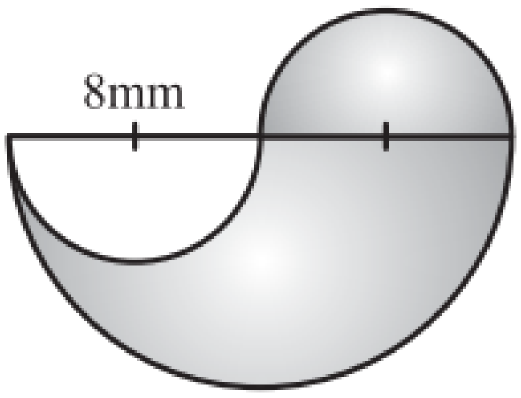
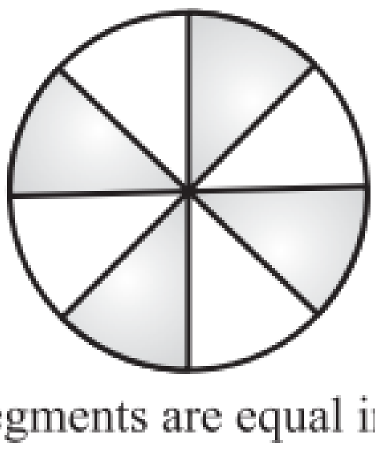
d)

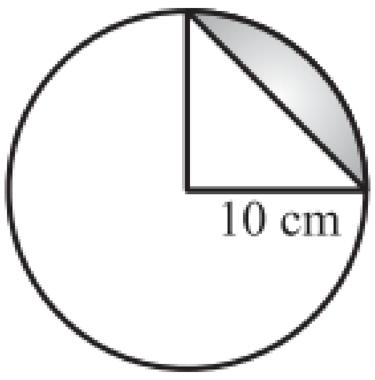


e)



All segments are equal in area and the circle has a radius of 1

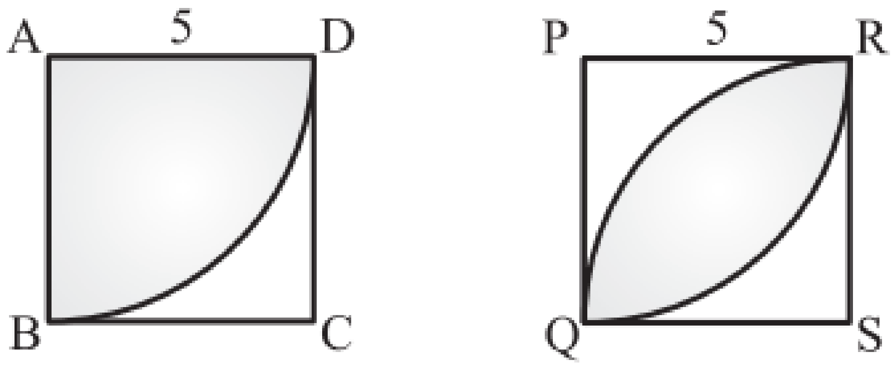
f)



Solutions to Exercise 1 number 4 are on page **346**

Mixed Exercise:

1) In the diagrams below, ABCD and PQRS are rectangles.



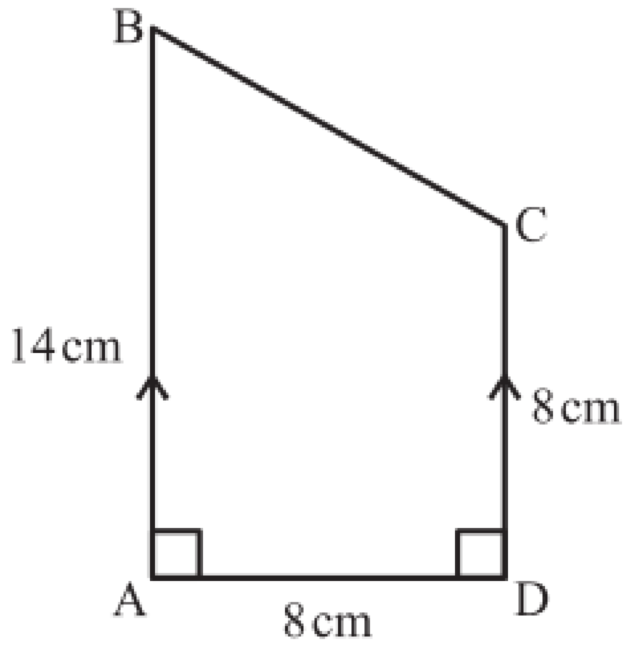
a) Determine the area of the unshaded region (BCD) in square ABCD. Round your answer to 1 decimal place.

b) Hence, determine the area of the shaded region of square PQRS.

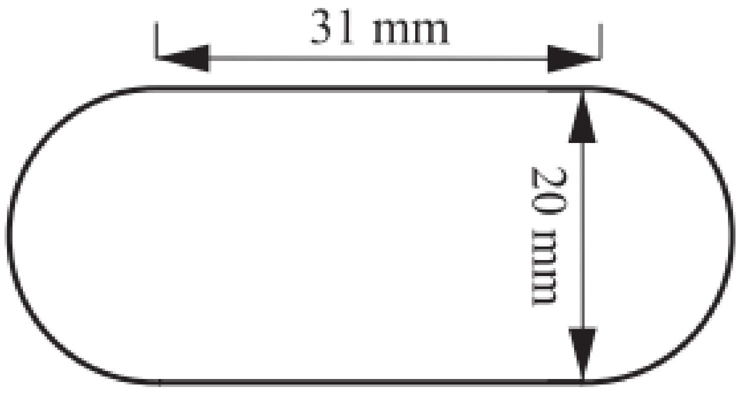
Solutions to the Mixed Exercise number 1 are on page **347**

2) Determine the perimeter and area of the shapes below. Give your answers correct to 1 decimal place where applicable.

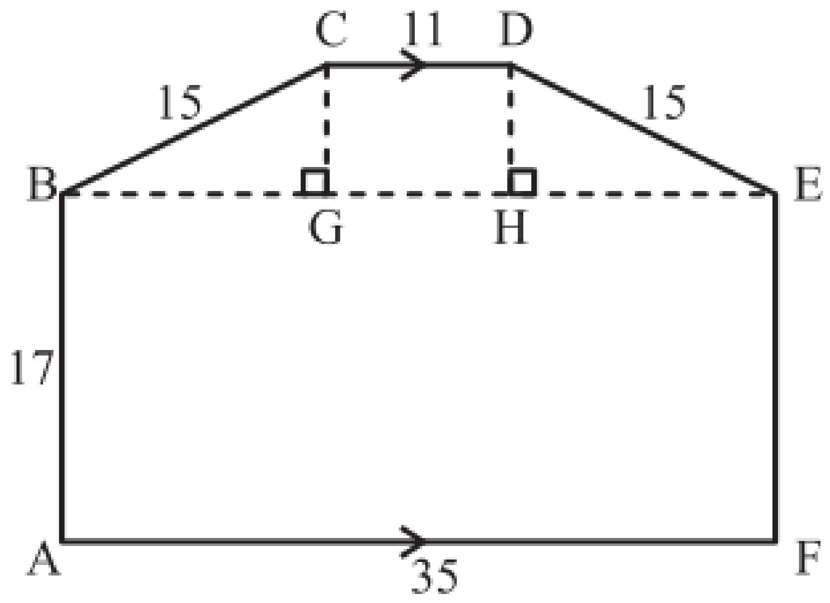
a)



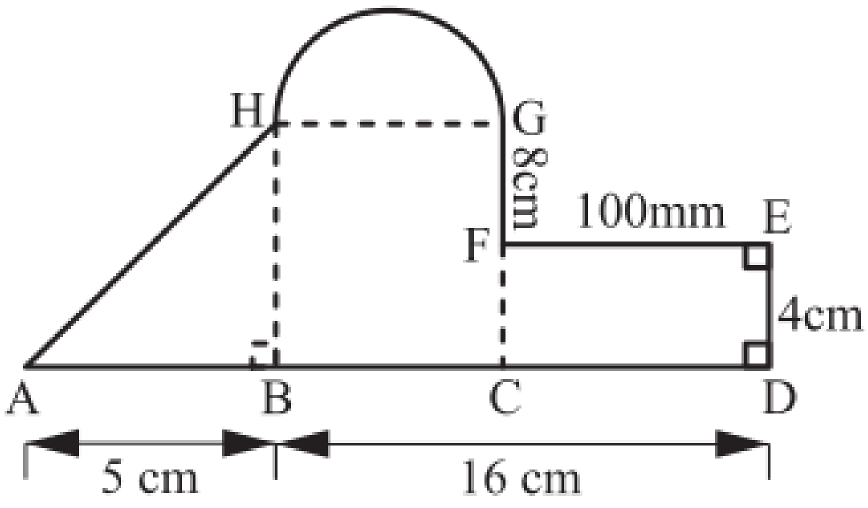
c)



b)

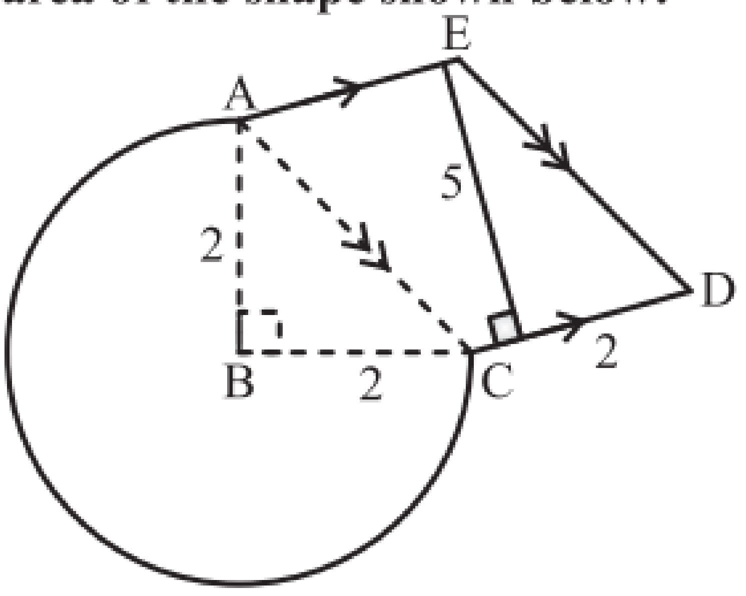


d)



Solutions to the Mixed Exercise number 2 are on page **347**

3) Determine the perimeter and area of the shape shown below:



Solutions to the Mixed Exercise number 3 are on page **348**

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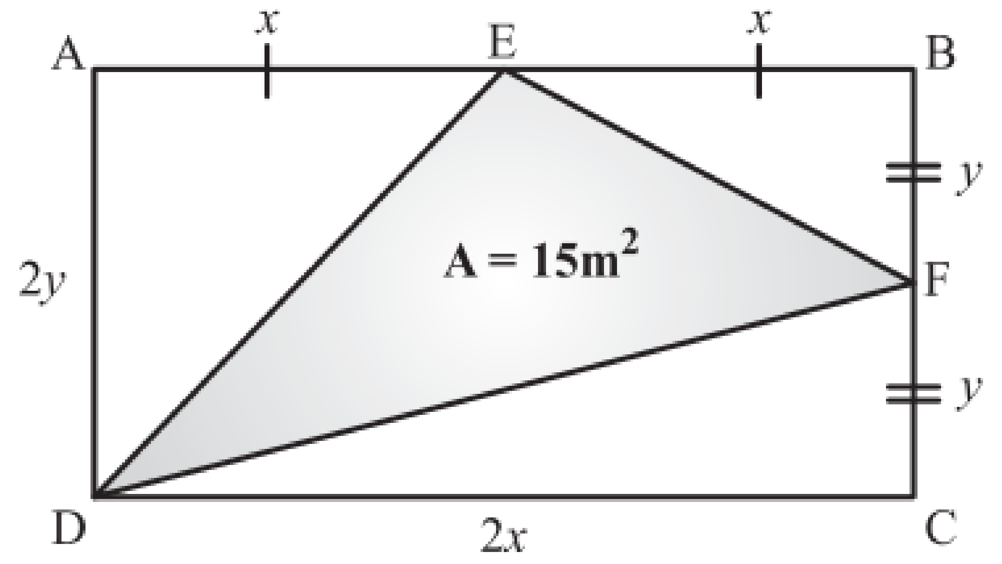
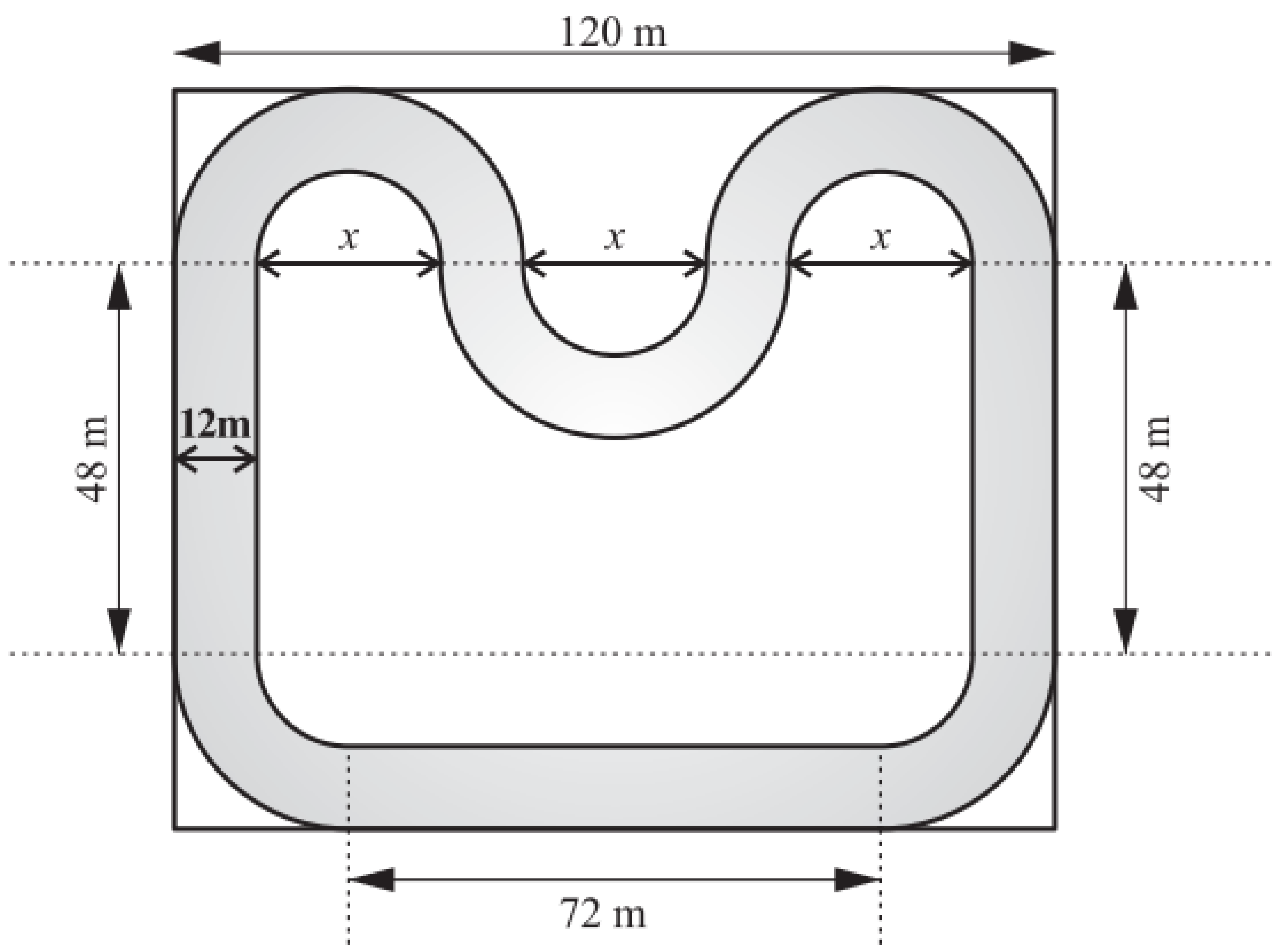
4) In the diagram below, ABCD is a rectangle and triangle DEF is formed by joining the midpoints of AB and BC.



a) Determine the area of rectangle ABCD in terms of x and y.
b) If the shaded area of triangle DEF is $15m^2$, determine the value of xy.
c) Hence, determine the area of triangle EBF.
d) The dimensions of triangle DEF are multiplied by a factor of k so that the new area of the triangle is $60m^2$. What is the value of k?

Solutions to the Mixed Exercise number 4 are on page **348**

5) The racetrack shown below has a width of 12m and is set on a rectangular piece of land 120m wide.



a) Determine the value of x.
b) Determine the width of the land the racetrack is constructed on.
c) Determine the area of a quarter circle bend of the racetrack.
d) Hence, determine the area that the racetrack occupies on the piece of land.
e) What is the value of the ratio of area of the land to the area of the racetrack?

Solutions to the Mixed Exercise number 5 are on page **349**

6) The decorative cube below is partially filled with water. It has dimensions as shown on the diagrams. When the cube is tilted, the water level reaches the midpoint of the tank as shown.

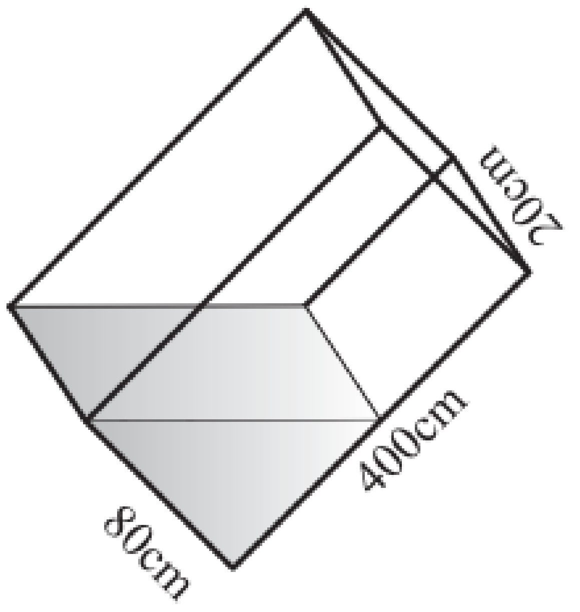


Diagram 1

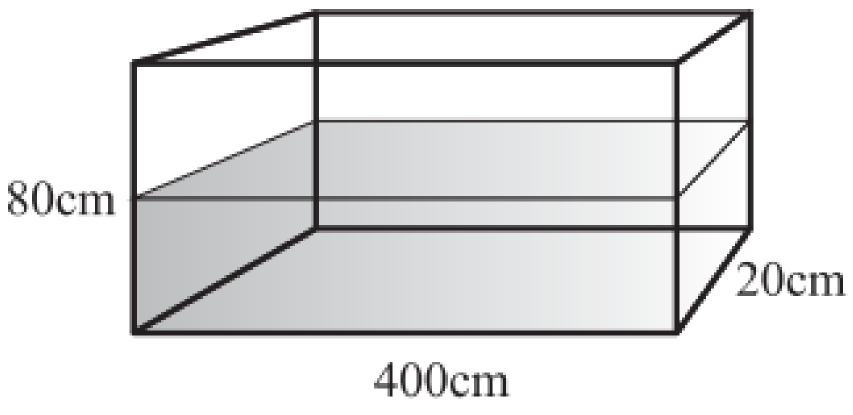


Diagram 2

a) Calculate the volume of water in the cube.
b) Hence, determine the height the water will reach when the cube is placed horizontally on a table as shown in the 2nd diagram above. (Remember that the diagrams above are not drawn to scale.)

Solutions to the Mixed Exercise number 6 are on page **349**

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Chapter 15 – Area and Perimeter (Solutions)

Exercise 1 Solutions:

1)

a) $P = 4s$

$32 = 4s$

$\therefore s = 8\,\text{cm}$

b) $A = l \times b$

$200 = 50 \times \text{width}$

$\therefore \text{width} = 4\,\text{cm} \rightarrow$ this is the same as $40\,\text{mm}$

c) $A_{\triangle} = \frac{1}{2}\text{base} \times \text{height}$

$= \frac{1}{2}(2)(2)$

$= 2\,\text{m}^2$

Exercise 1 number 1 is on page **343**

2)

a) $AB^2 = 9^2 + 12^2$

$\therefore AB = 15\,\text{m}$

$P = 15 + 4 + 9 + 12 + 10$

$= \mathbf{50}\,\text{m}$

$A = \frac{1}{2}(4 + 22)(9)$

$= \mathbf{117}\,\text{m}^2$

b) $BC^2 = 12^2 + 5^2$

$\therefore BC = 13\,\text{m}$

$P = 30 + 37 + 13$

$= \mathbf{80}\,\text{m}$

$A = \frac{1}{2}(30)(12)$

$= \mathbf{180}\,\text{m}^2$

c) $P = 10 + 10 + 8 + 8$

$= \mathbf{36}\,\text{m}$

$A = \frac{1}{2}(10)(9)$

$= \mathbf{45}\,\text{m}^2$

d) $AB^2 = 6^2 + 8^2$

$\therefore AB = 10\,\text{units}$

$BC^2 = 15^2 + 8^2$

$\therefore BC = 17\,\text{units}$

$P = 2(17) + 2(10)$

$= \mathbf{54}\,\text{units}$

$A = \frac{(21)(16)}{2}$

$= \mathbf{168}\,\text{units}^2$

e) $P = 34 + 33 + 22$

$= \mathbf{89}\,\text{m}$

$A = \frac{1}{2}(22)(32)$

$= \mathbf{352}\,\text{m}^2$

f) $P = \frac{3}{4}(2\pi)(8) + 8 + 8$

$= 12\pi$

$= \mathbf{53{,}7}\,\text{mm}$

$A = \frac{3}{4}\pi(8)^2$

$= 48\pi$

$= \mathbf{150{,}8}\,\text{mm}^2$

Exercise 1 number 2 is on page **343**

3)

a) $2x + 14 = 26$

$x = 6\,\text{cm}$

b) $\frac{1}{2}(2)CD = 4$

$\therefore CD = 4\,\text{cm}$

$x^2 = 3^2 + 4^2$

$\therefore x = 5\,\text{cm}$

c) $(5)(x) = 44{,}55$

$x = 8{,}91\,\text{m}$

d) $\frac{(2x)(x)}{2} = 16$

$\therefore x^2 = 16$

$\therefore x = 4\,\text{mm}$

e) $\frac{1}{2}(11 + 15)(x) = 39$

$\therefore x = 3\,\text{mm}$

f) $\pi(10)^2 - \pi x^2 = 84\pi$

$\therefore -\pi x^2 = 84\pi - 100\pi$

$\therefore -\pi x^2 = -16\pi$

$\therefore x^2 = 16$

$\therefore x = 4$ units

Exercise 1 number 3 is on page **343**

4)

a) $A_{sh} = \pi(5)^2 - \pi(2{,}5)^2$

$= 58{,}9\,\text{m}^2$

b) $A_{sh} = \frac{1}{2}(10)(5) - \pi(2)^2$

$= 12{,}4\,\text{units}^2$

c) $A_{sh} = (12)^2 - \pi(6)^2$

$= 30{,}9\,\text{m}^2$

d) $A_{sh} = \frac{1}{2}(\pi)(8)^2$

$= 100{,}5\,\text{mm}^2$

e) $A_{sh} = 4\left(\frac{1}{8}\right)(\pi)(1)^2$

$= 1{,}6\,\text{units}^2$

f) $A_{sh} = \left(\frac{1}{4}\right)(\pi)(10)^2 - \frac{1}{2}(10)(10)$

$= 28{,}5\,\text{cm}^2$

Exercise 1 number 4 *a* to *c* is on page **343** and *d* to *f* is on page **344**

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Mixed Exercise Solutions:

1)

a) $A_{\square} = 5^2$

$= 25$

$A_{shaded} = \frac{1}{4} \times \pi (5)^2$

$= \frac{25\pi}{4}$

$A_{unshaded} = 25 - \frac{25\pi}{4}$

$= 5{,}4 \text{ units}^2$

b) $A_{shaded} = A_{\square} - A_{unshaded}$

$= 25 - 2(5{,}4)$

$= 14{,}2 \text{ units}^2$

The Mixed Exercise number 1 is on page 344

2)

a) $BC^2 = 6^2 + 8^2$

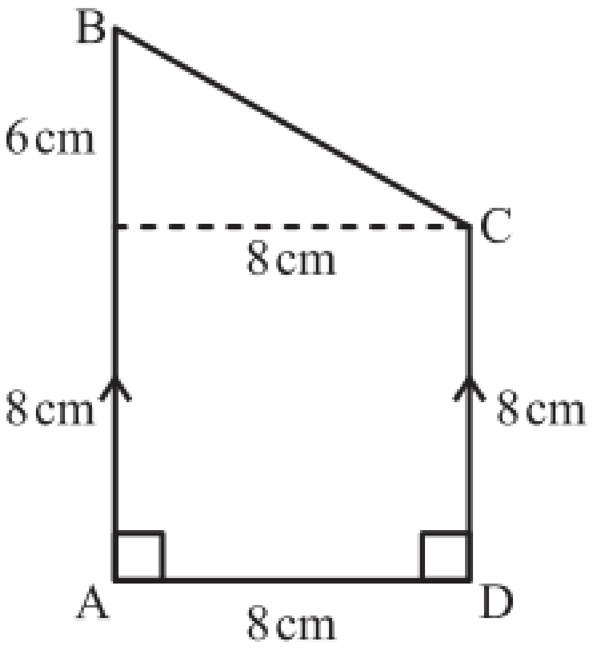
$\therefore BC = 10 \text{ cm}$

$P = 8 + 14 + 10 + 8$

$= \mathbf{40} \text{ cm}$

$A = 8(8) + \frac{1}{2}(8)(6)$

$= \mathbf{88} \text{ cm}^2$



b) $P = 35 + 17 + 15 + 11 + 15 + 17$

$= \mathbf{110} \text{ units}$

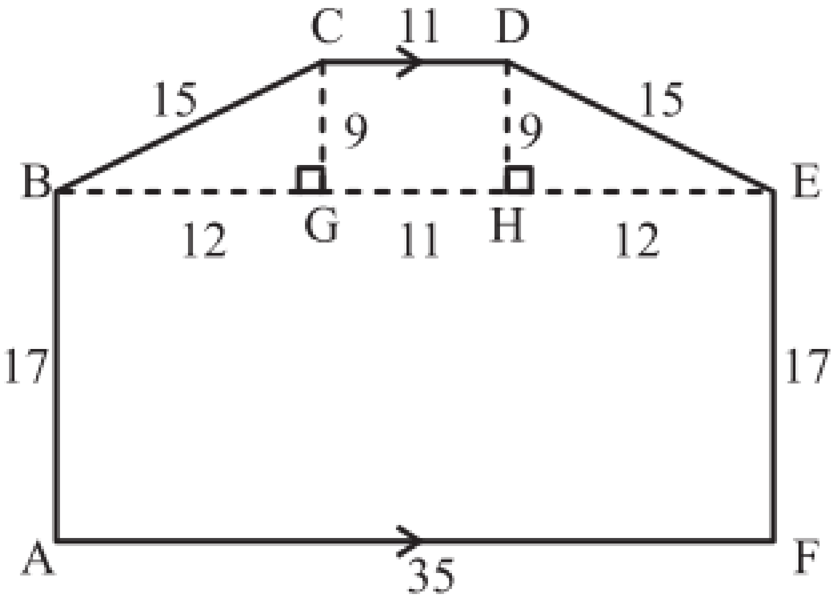
$BG = 12 \text{ units}$

$CG^2 = 15^2 - 12^2$

$\therefore CG = 9 \text{ units}$

$A = 17(35) + \frac{1}{2}(35 + 11)(9)$

$= \mathbf{802} \text{ units}^2$

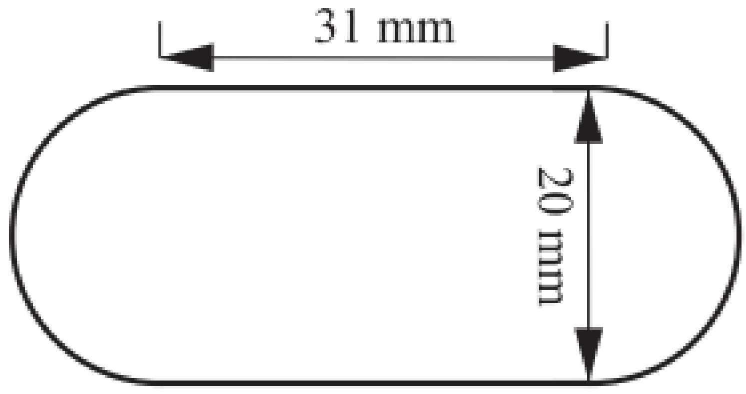


c) $P = 31 + 31 + 2\pi(10)$

$= \mathbf{124{,}8} \text{ mm}$

$A = 31(20) + \pi(10)^2$

$= \mathbf{934{,}2} \text{ mm}^2$



d) $AH^2 = 5^2 + 12^2$

$\therefore AH = 13 \text{ cm}$

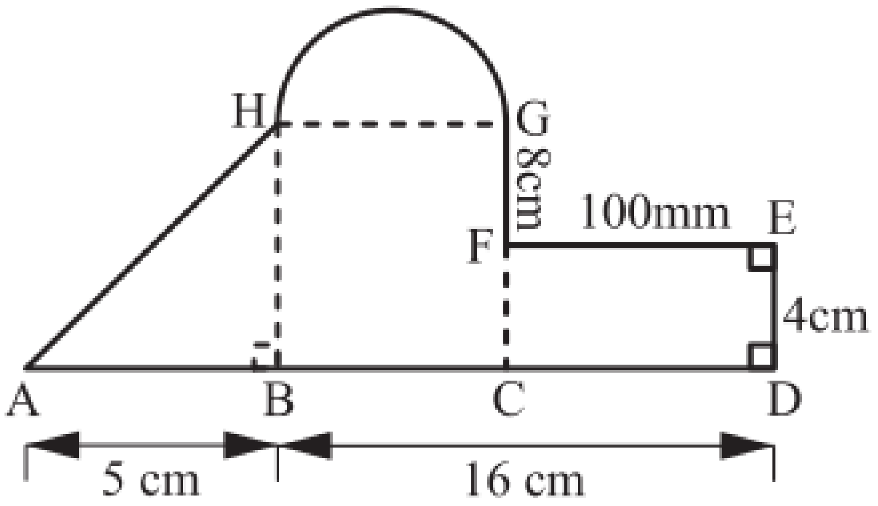
$P = 13 + \frac{1}{2}\pi(6) + 8 + 10 + 4 + 16 + 5$

$= \mathbf{65{,}42} \text{ cm}$

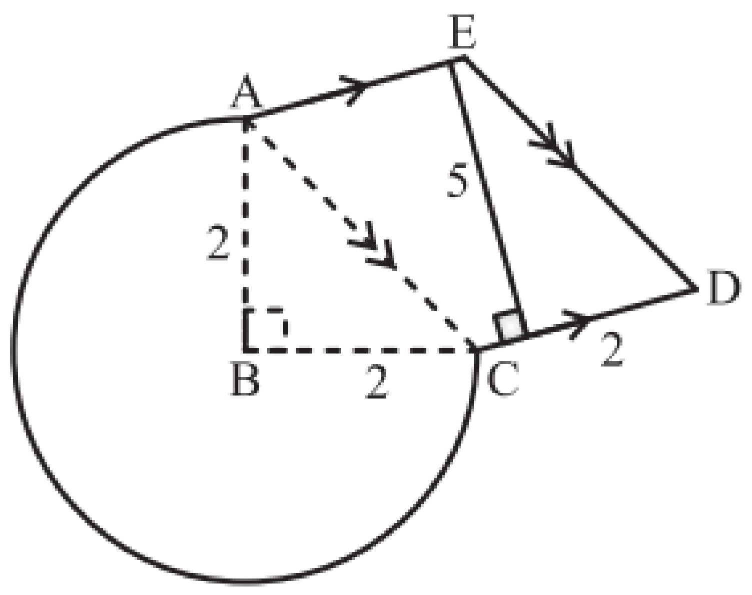
$A = A_{\triangle} + A_{semi\text{-}circle} + A_{rectangle} + A_{rectangle}$

$= \frac{1}{2}(5)(12) + \frac{1}{2}\pi(3)^2 + (4)(10) + (6)(12)$

$= \mathbf{156{,}1} \text{ cm}^2$



The Mixed Exercise number 2 is on page 344



3) $AC^2 = 2^2 + 2^2$

$\therefore AC = \sqrt{8} = 2\sqrt{2} \rightarrow AC = ED$

$P = \frac{3}{4}P_{circle} + AE + ED + CD$

$= \frac{3}{4}(2)(\pi)(2) + 2 + 2\sqrt{2} + 2$

$= 16,3\text{ units}$

$A = \frac{3}{4}A_{circle} + A_{triangle} + A_{parm}$

$= \frac{3}{4}(\pi)(2)^2 + \frac{1}{2}(2)(2) + (2)(5)$

$= 21,4\text{ units}^2$

The Mixed Exercise number 3 is on page 344

4)

a) $A_{ABCD} = 2x \times 2y$

$= 4xy$

b) $A_{shaded} = A_{rectangle} - A_{unshaded}$

$A_{unshaded} = \frac{1}{2}(2y)(x) + \frac{1}{2}xy + \frac{1}{2}(2y)(x)$

$= xy + \frac{1}{2}xy + xy$

$= \frac{5xy}{2}$

$\therefore 15 = 4xy - \frac{5xy}{2} \rightarrow LCD = 2$

$\therefore 15 = \frac{8xy - 5xy}{2}$

$\therefore 15 = \frac{3xy}{2} \rightarrow$ multiply both sides by 2

$\therefore 30 = 3xy \rightarrow$ divide both sides by 3

$\therefore xy = 10$

c) $A_{EBF} = \frac{1}{2}EB \times BF$

$= \frac{1}{2}xy$

$= \frac{1}{2}(10)$

$= 5\text{ m}^2$

d) The area has increased by a factor of **4**. Therefore, the dimensions were multiplied by **2**. Therefore, **k = 2**.

The Mixed Exercise number 4 is on page 345

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5)

a) $12+x+12+x+12+x+12=120$

$\therefore 3x+48=120$

$\therefore 3x=72$

$\therefore x=24\,\text{m}$

b) $$\text{width of land} = 12+\frac{x}{2}+48+\frac{x}{2}+12$$
$$=12+12+48+12+12$$
$$=96\,\text{m}$$

c) $$\text{Area}_{\text{bend}} = \frac{1}{4}\left(\text{A}_{\text{large circle}}-\text{A}_{\text{small circle}}\right)$$
$$=\frac{1}{4}\left[\pi\left(\frac{x}{2}+12\right)^2-\pi\left(\frac{x}{2}\right)^2\right]$$
$$=\frac{1}{4}\left[\pi\left(\frac{24}{2}+12\right)^2-\pi\left(\frac{24}{2}\right)^2\right]$$
$$=\frac{1}{4}\left[\pi(24)^2-\pi(12)^2\right]$$
$$=339,3\,\text{m}^2$$

d) $$\text{A} = \overset{\text{vertical straight}}{2(48)(12)} + \overset{\text{horizontal straight}}{(72)(12)} + \overset{\text{bends}}{(8)(339,3)}$$
$$=1152+864+2\,714,4$$
$$=4\,730,4\,\text{m}^2$$

e) $$\frac{\text{Area of land}}{\text{Area of track}}$$
$$=\frac{120\times 96}{4\,730,4}$$
$$=2,44$$

The Mixed Exercise number 5 is on page **345**

6)

a) $$\text{V}_{\triangle}=\frac{1}{2}(\text{base})(\perp\text{ height})(\text{Height})$$
$$=\frac{1}{2}(80)(20)(20)$$
$$=16\,000\,\text{cm}^3$$

b) $\text{V}_{\text{rect}} = \text{length}\times\text{breadth}\times\text{height}$

$\therefore 16\,000=400(20)(\text{height})$

$\therefore 16\,000=8\,000(\text{height})$

$\therefore \text{height}=2\,\text{cm}$

The Mixed Exercise number 6 is on page **345**

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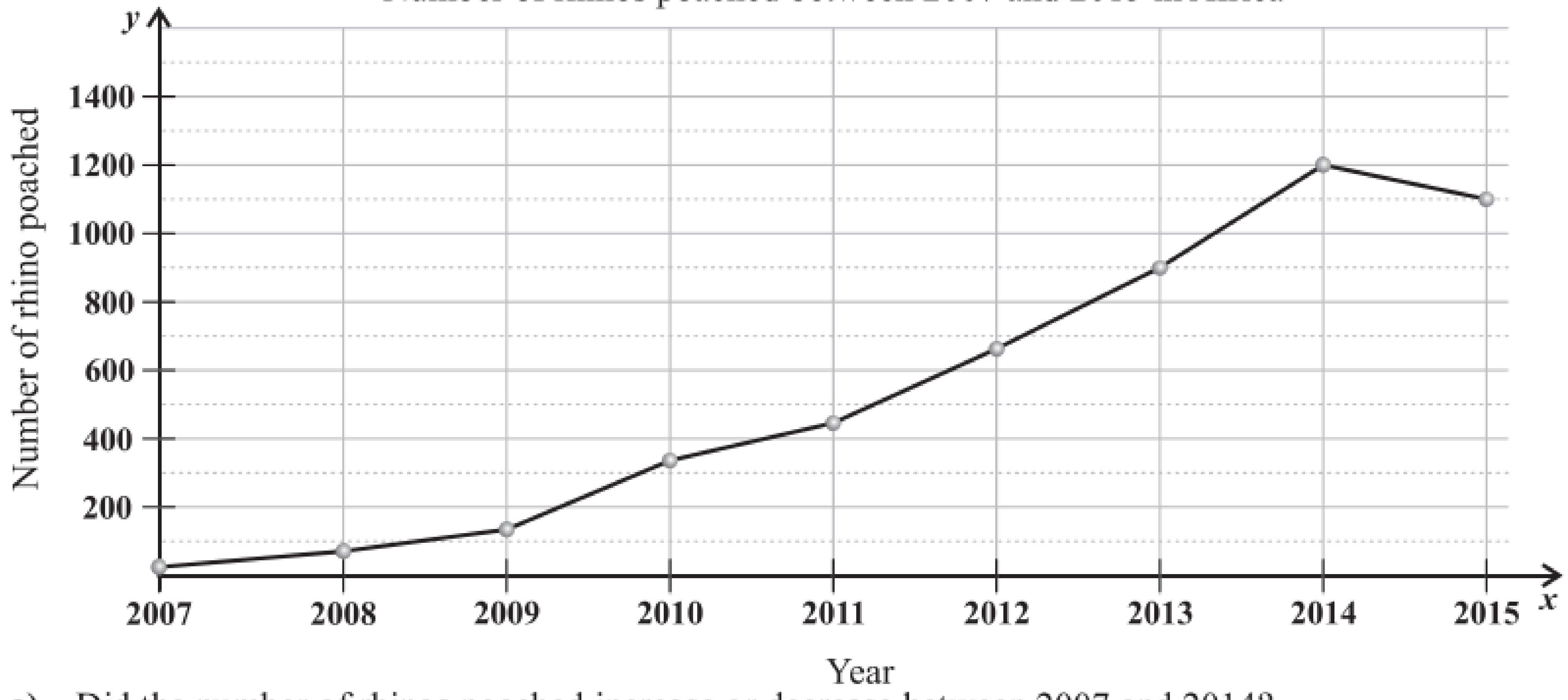
Chapter 16 – Linear Functions

Grade 8 revision (from page 161 - 163)

Exercise 1:

1) Africa has a growing problem with rhino poaching. In 1960 there were approximately 100 000 black rhinos in Africa and today there are less than 5 000. To raise awareness about the plight of rhinos in Africa, Sibusiso plots the graph below to show to his Grade 9 mathematics class.

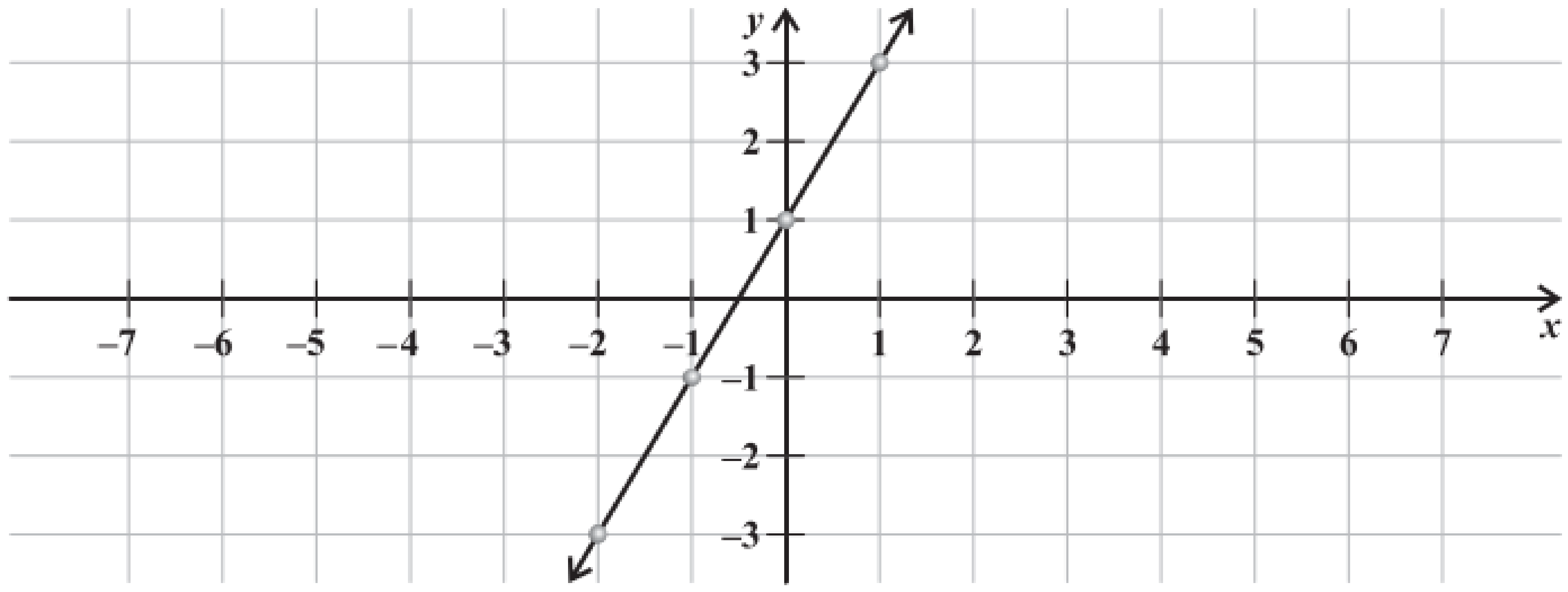
Number of rhinos poached between 2007 and 2015 in Africa



a) Did the number of rhinos poached increase or decrease between 2007 and 2014?
b) How many rhinos were poached in 2014?
c) In which year were 900 rhinos poached?
d) In which year was there a decrease in rhino poaching?
e) In which year were 680 rhinos poached?
f) Sibusiso has made an error in plotting his graph. What error did he make?

Solutions to Exercise 1 number 1 are on page 355

2) Examine the graph shown below:



a) Use the graph to fill in the table below:

x	–2		1	
y		1		–1

b) Choose the equation which best models the graph and table above:

1) $y = x + 2$	**2)** $y = 2x + 1$
3) $y = 2x - 1$	**4)** $y = 2x + 2$

c) Is the graph increasing or decreasing?

Solutions to Exercise 1 number 2 are on page 355

Horizontal and Vertical Lines (from page 164)

Exercise 2:

1) Sketch the following graphs on the same set of axes:

a) $x = 3$
b) $y = -4$
c) $x = -2$
d) $y = 4$
e) $x = -6$
f) $y = 2$
g) $x = 6$
h) $y = -2$

Solutions to Exercise 2 number 1 are on page 355

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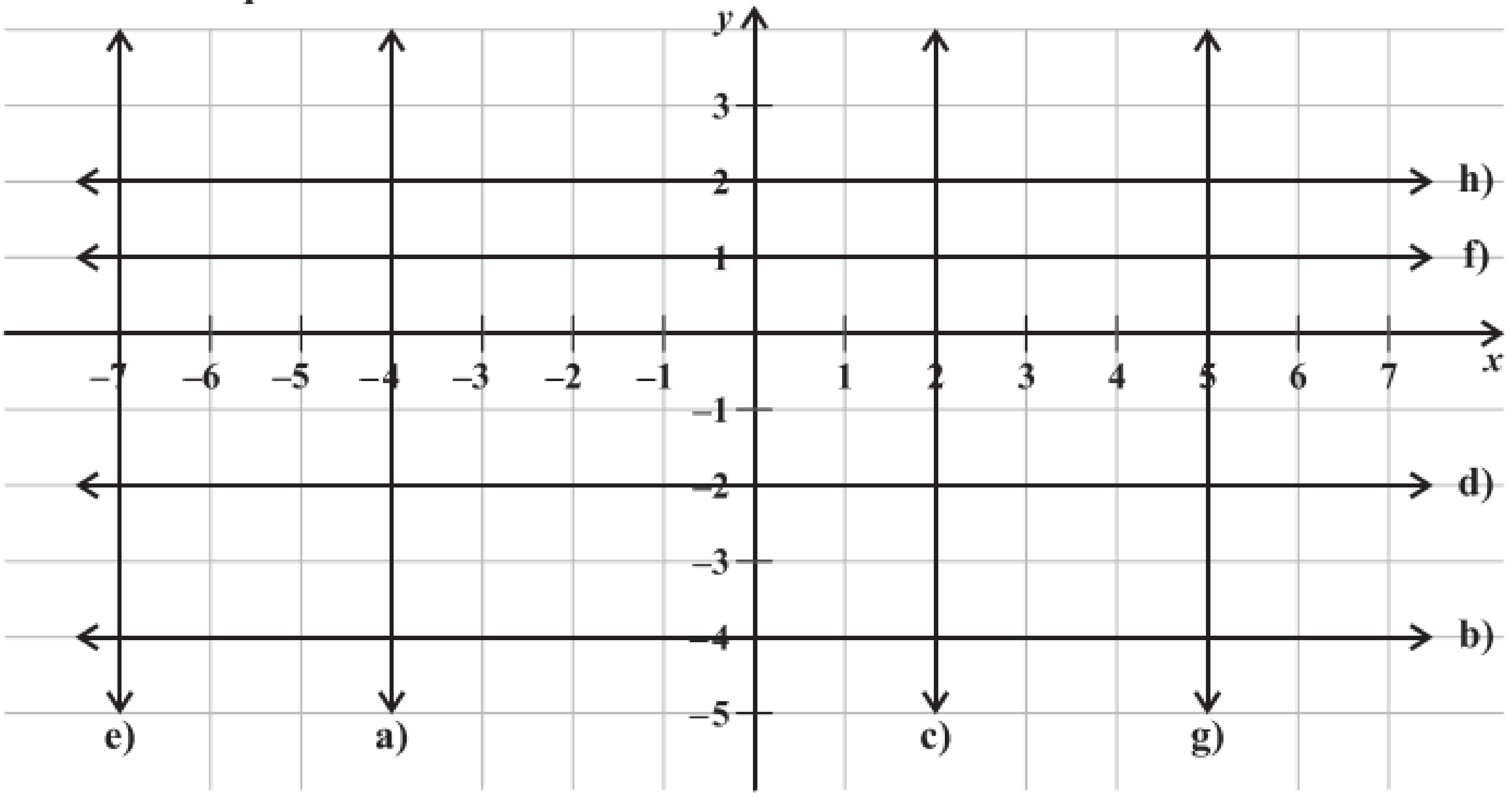
2) Write down the equation of each line shown below:



Solutions to Exercise 2 number 2 are on page **355**

The Straight Line Graph (from pages 165 - 169)

Exercise 3:

1) Sketch the following graphs using the table method:

a) $y = 2x - 1$

b) $y = -2x - 1$

c) $y = 2x + 1$

d) $y = \frac{1}{2}x + 2$

e) $y = -x + 4$

f) $y = -\frac{x}{3} + 2$

Solutions to Exercise 3 number 1*a* and *b* are on page **355** and *c* to *f* are on page **356**

2) Sketch the following graphs using the dual intercept method. Show all your calculations clearly.

a) $y = \frac{2}{3}x + 2$

b) $y = -x + 1$

c) $y = -x - 3$

d) $y = -\frac{1}{2}x - 1$

e) $y = -\frac{4}{3}x + 4$

f) $y = x + 2$

Solutions to Exercise 3 number 3*a* to *d* are on page **356** and *e* and *f* are on page **357**

3) Sketch the following graphs using the gradient intercept method. Show all your calculations clearly.

a) $y = \frac{1}{2}x - 1$

b) $y = 2x - 3$

c) $y = \frac{x}{3} - 4$

d) $y = x$

e) $y = -x$

f) $y = -\frac{1}{2}x + 3$

Solutions to Exercise 3 number 3 are on page **357**

Determining the Gradient of a Straight Line (from pages 170 - 173)

Exercise 4:

1) A straight line passes through the points (–2;5) and (3;6). The gradient of the line is:

A	5	C	–5
B	$-\frac{1}{5}$	D	$\frac{1}{5}$

Solutions to Exercise 4 number 1 are on page **357**

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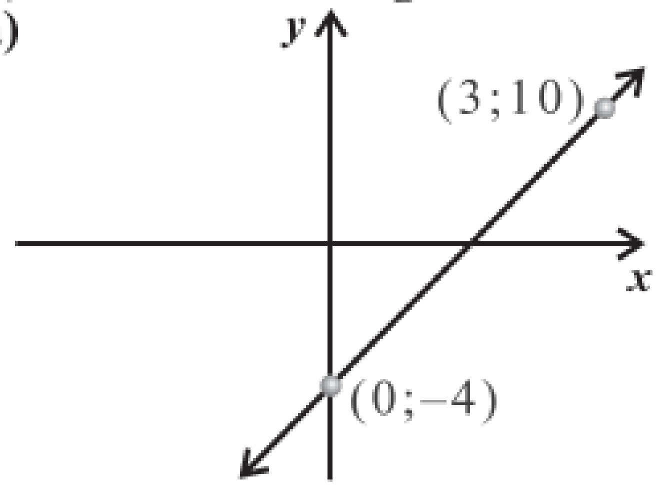
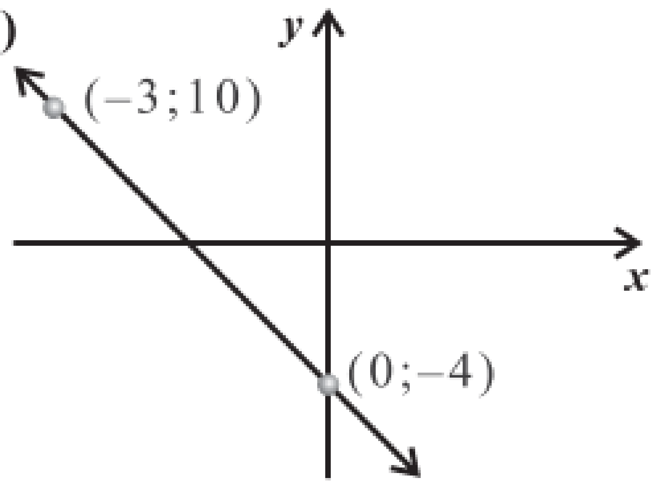
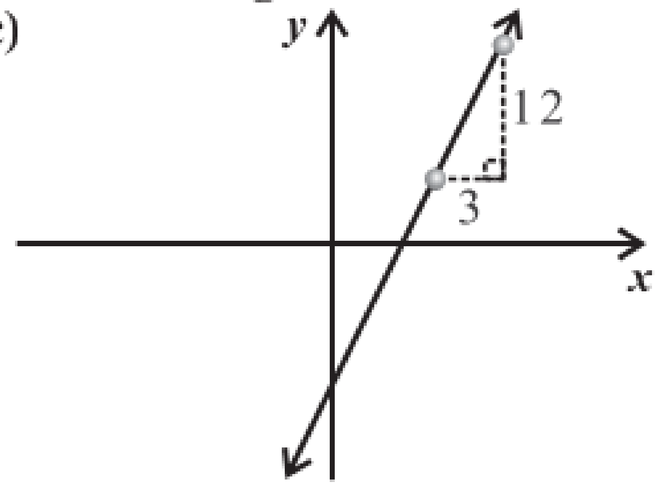
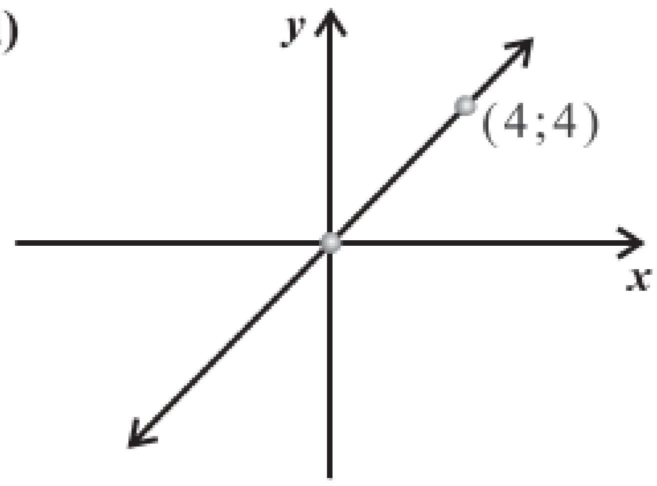
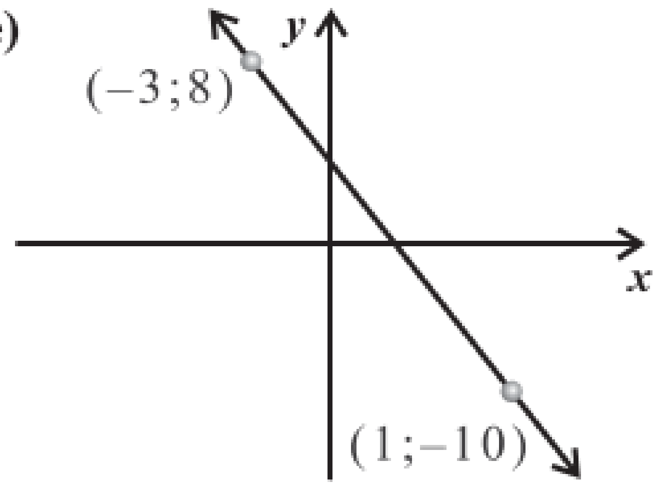
2) Determine the gradient of each line the diagrams below:

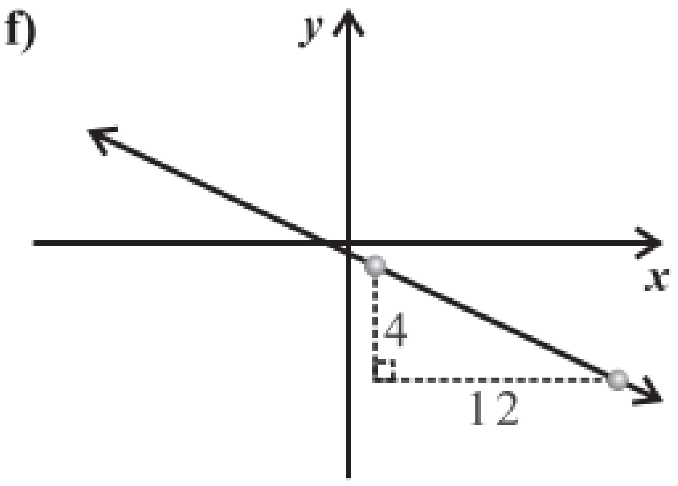
a)


b)


c)


d)


e)


f)


Solutions to Exercise 4 number 2*a* to *c* are on page **357** and numbers *d* to *f* are on page **358**

3) The equations of various straight lines are given below. Determine the gradient of each line.

a) $y = 2x - 1$

b) $2y + 3 = 2x + 5$

c) $3y + 2x - 10 = 0$

d) $5y = 10 - 15x$

e) $3y + 2 = x$

f) $8y - 5x + 102 = 5$

g) $2y + 10x = 1032545$

h) $y = 0x + 10$

i) $y = -5$

Solutions to Exercise 4 number 3 are on page **358**

4) Determine the gradient of line AB given the points below:

a) A(5 ; 3) and B(–3 ; 2)

b) A(–10 ; –5) and B(–20 ; –30)

c) A(–4 ; 4) and B(4 ; –3)

d) A(–7 ; 2) and B(255 ; 2)

e) A(–10 ; –12) and B(4 ; 3)

f) A(2 ; 12) and B(2 ; 5)

Solutions to Exercise 4 number 4 are on page **358**

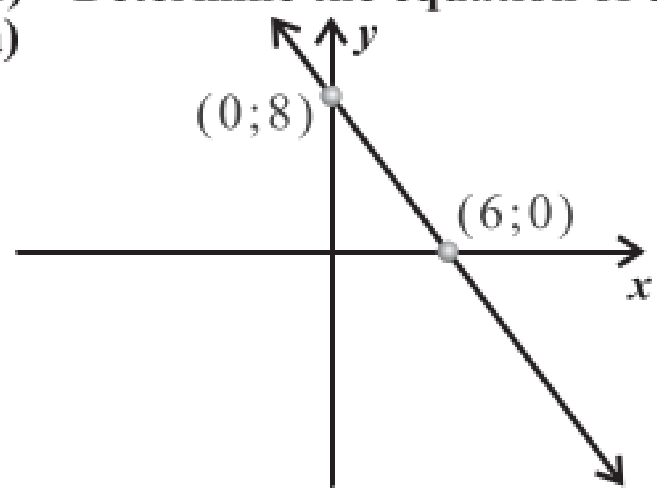
5) The gradient between points A(–5 ; 8) and B(3; *y*) is 2. Determine the value of *y*.

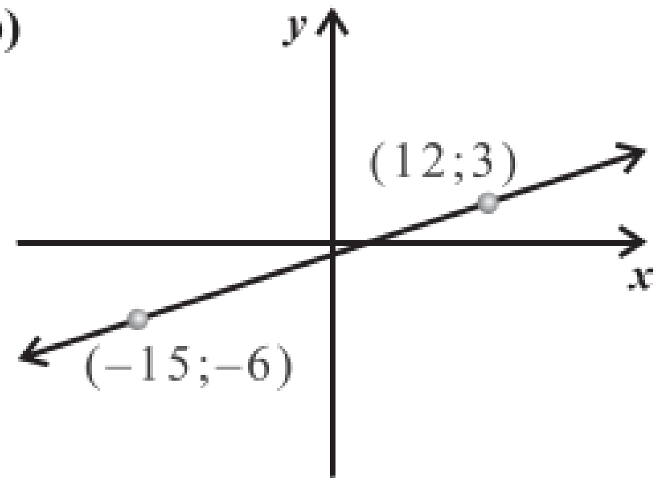
Solutions to Exercise 4 number 5 are on page **358**

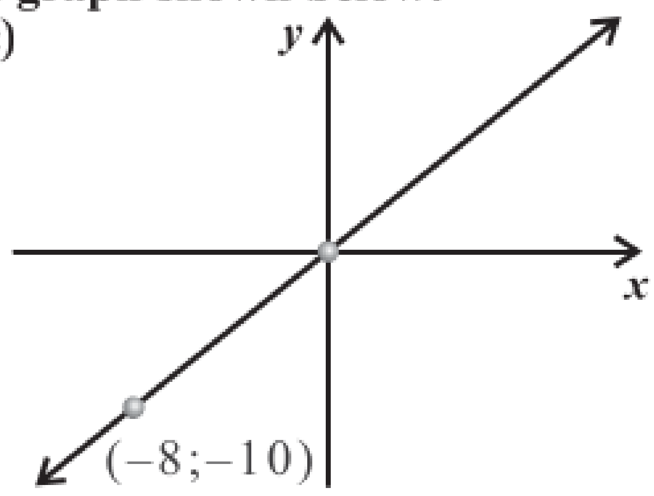
Determining the Equation of a Straight Line (from pages 174 and 175)

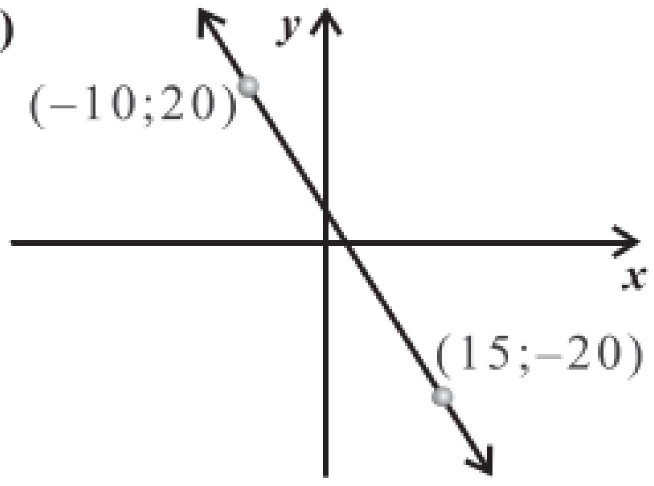
Exercise 5:

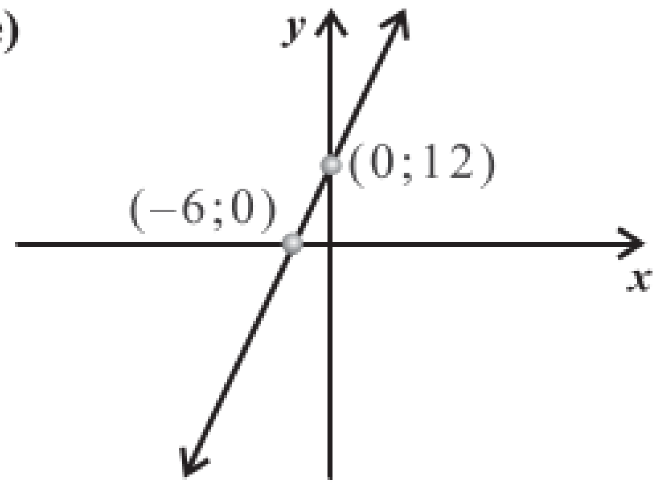
1) Determine the equation of each graph shown below:

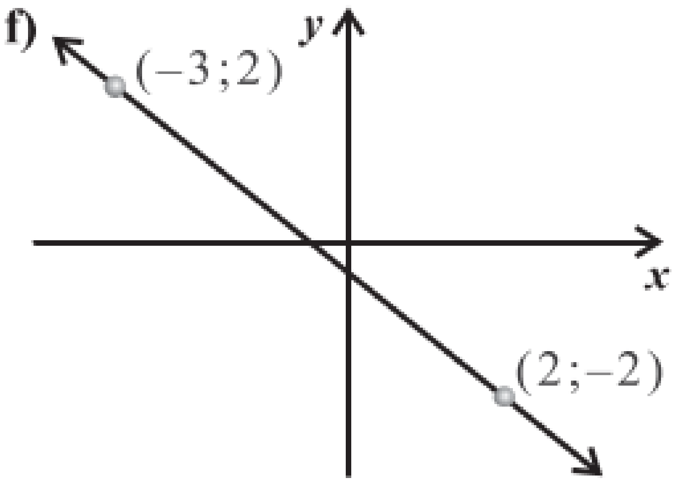
a)


b)


c)


d)


e)


f)


Solutions to Exercise 5 number 1 are on page **359**

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2) Determine the equation of the straight lines passing through the points:

a) (2 ; 3) and (–4 ; –3) **b)** (6 ; –13) and (–1 ; 8) **c)** (–4 ; 12) and (3 ; –23)

Solutions to Exercise 5 number 2 are on page **359**

Extension (parallel and perpendicular lines) (from pages 176 and 177)

Exercise 6:

1) Determine the equations of the following lines:

a) The line passes through the point A(0;5) and is parallel to the line $y = -3x + 10$.

b) The line passes through the point P(8;3) and is parallel to the line $y = -5x + 2$.

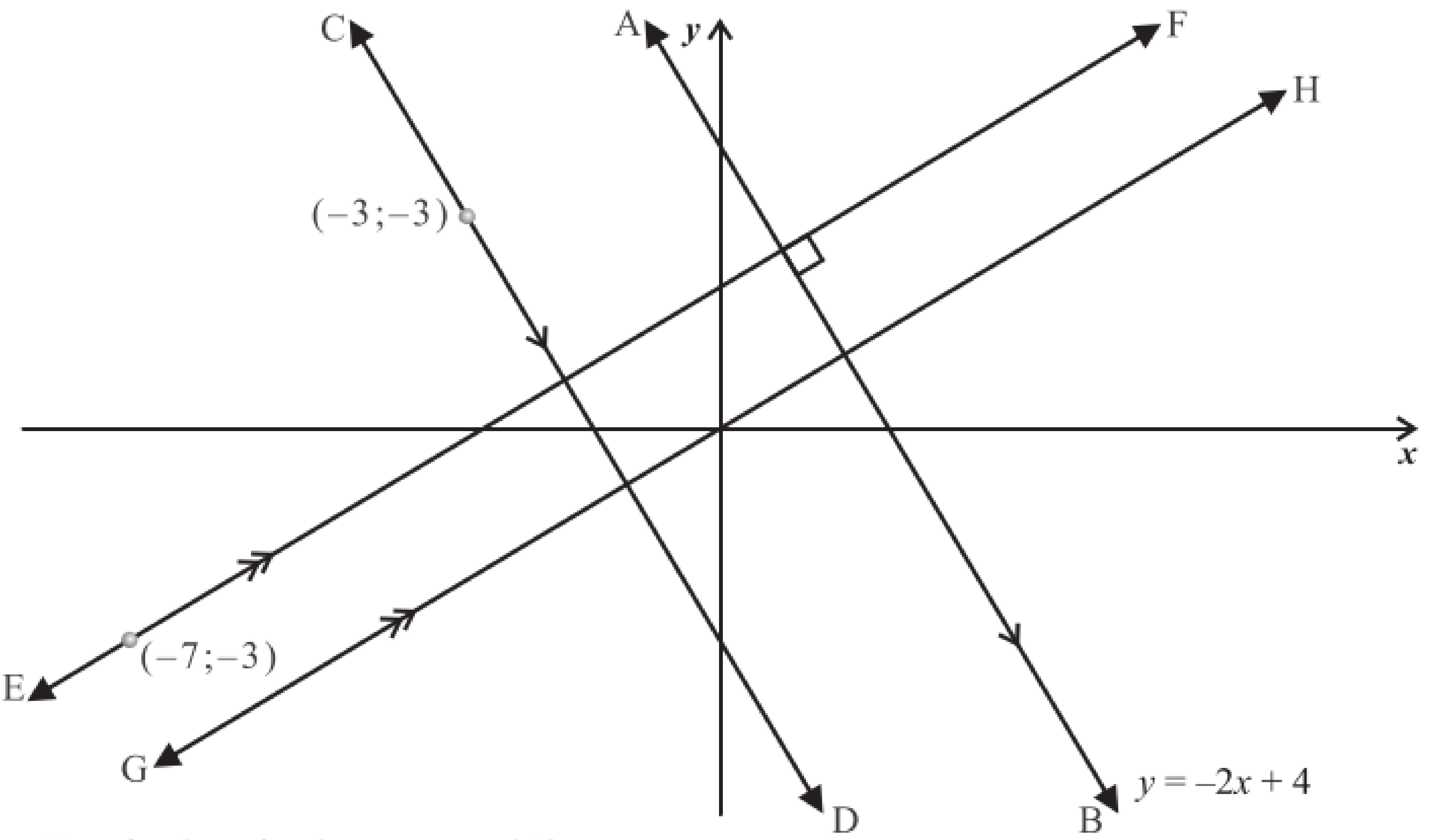
c) The line passes through the point C(9;–2) and is perpendicular to the line $y = -\frac{3}{2}x + \frac{5}{2}$

d) The line is perpendicular to the line $x = 2$ and passes through the point (2;–3).

Solutions to Exercise 6 number 1 are on page **359**

2) Line AB below has the equation $y = -2x + 4$. Determine the equation of line:

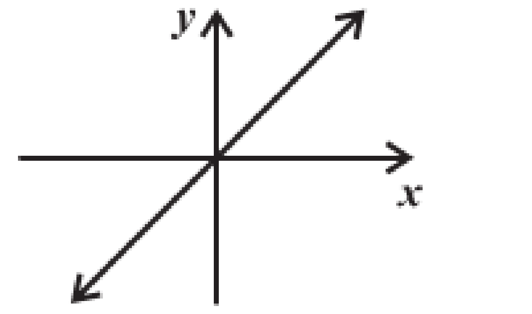
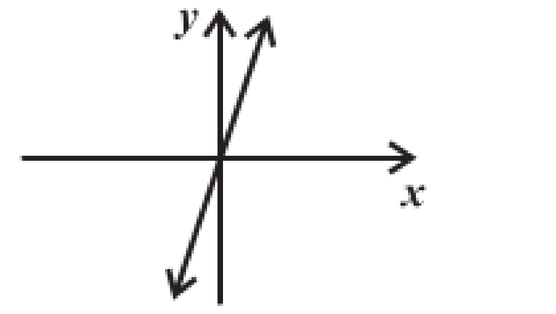
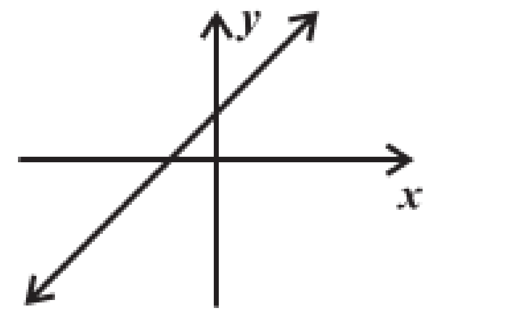
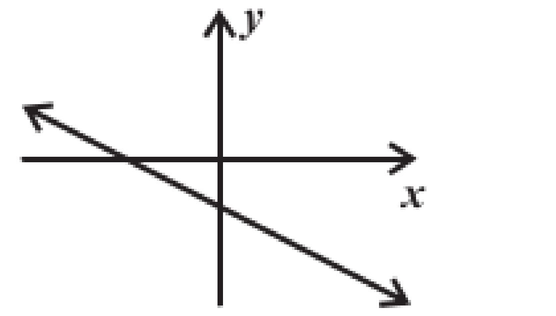
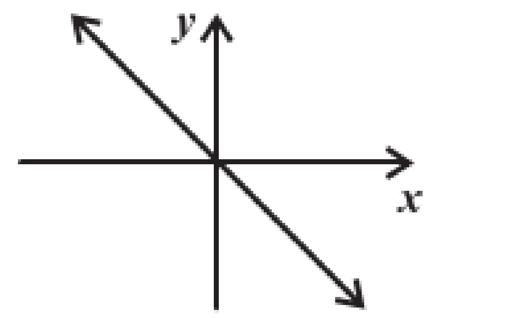
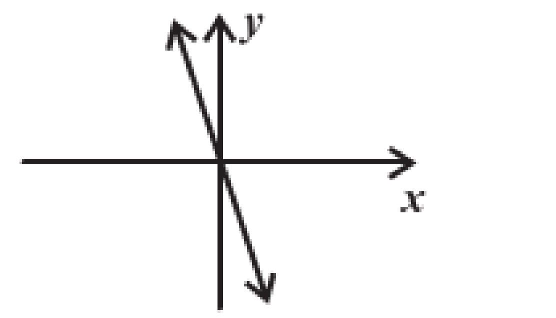
a) CD **b)** EF **c)** GH



Solutions to Exercise 6 number 2 are on page **359**

Mixed Exercise:

1) Match each of the graphs below with their correct equation:

A		**D**		**1**	$y = -\frac{x}{2} - 2$	**4**	$y = -x$
B		**E**		**2**	$y = -3x$	**5**	$y = x + 1$
C		**F**		**3**	$y = x$	**6**	$y = 3x$

Solutions to the Mixed Exercise number 1 are on page **360**

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2) State whether the following statements are true or false. If the statement is false correct it.

a) The line $y = -5x + 10$ has a gradient of 10.

b) The gradient (m) of the line passing through the points (8 ; –5) and (–3 ; 4) is $\dfrac{4-5}{-3-8}$.

c) The equation of the x-axis is $y = 0$.

d) The line passing through the point (–2 ; –4) and the origin has a gradient of 2.

Solutions to the Mixed Exercise number 2 are on page **360**

3) The point (b ; –5) lies on the line $y = -3x + 10$. Determine the value of b.

Solutions to the Mixed Exercise number 3 are on page **360**

4) The point (3 ; p) lies on the line $y = 8x - 4$. Determine the value of p.

Solutions to the Mixed Exercise number 4 are on page **360**

5) Does the point Q(3 ; 1) lie on the line $y = 2x - 6$? Show calculations to verify your answer.

Solutions to the Mixed Exercise number 5 are on page **360**

6) Sketch the following graphs:

a) $y = \dfrac{x}{2}$

b) $y = -\dfrac{1}{2}x + 1$

Solutions to the Mixed Exercise number 6 are on page **360**

7) Determine the equation of the line passing through points:

a) (5 ; 8) and (0 ; 4)

b) (1 ; 8) and (2 ; 0)

Solutions to the Mixed Exercise number 7 are on page **360**

8) Write down the gradient and coordinates of the y-intercept of each of the lines below:

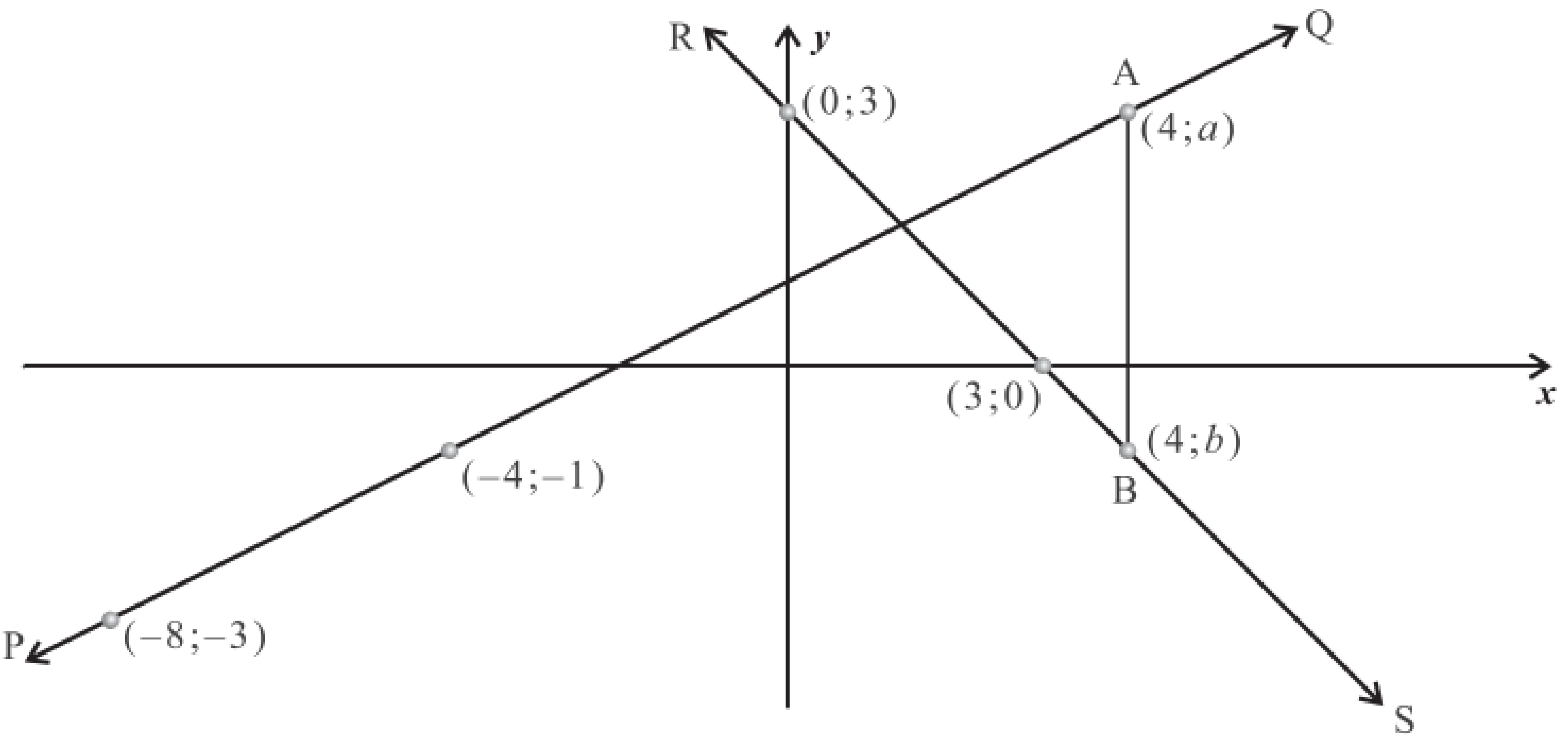
a) $2y + 3x - 5 = 0$

b) $4y - 3 = -2x$

c) $6y - 16x + 5 = 2x + 6$

Solutions to the Mixed Exercise number 8 are on page **360**

9) The lines of PQ and RS are shown below:



a) Determine the equations of PQ and RS.

b) Determine the value of a and b.

c) Hence, determine the length of the vertical line AB.

Solutions to the Mixed Exercise number 9 are on page **361**

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Chapter 16 – Linear Functions (Solutions)

Exercise 1 Solutions:

1)

a) Increase

b) 1 200

c) 2013

d) 2015

e) 2012

f) The graph should be a discrete graph. Sibusiso should not have joined the points.

Exercise 1 number 1 is on page **350**

2)

a)

x	–2	**0**	1	**–1**
y	**–3**	1	**3**	–1

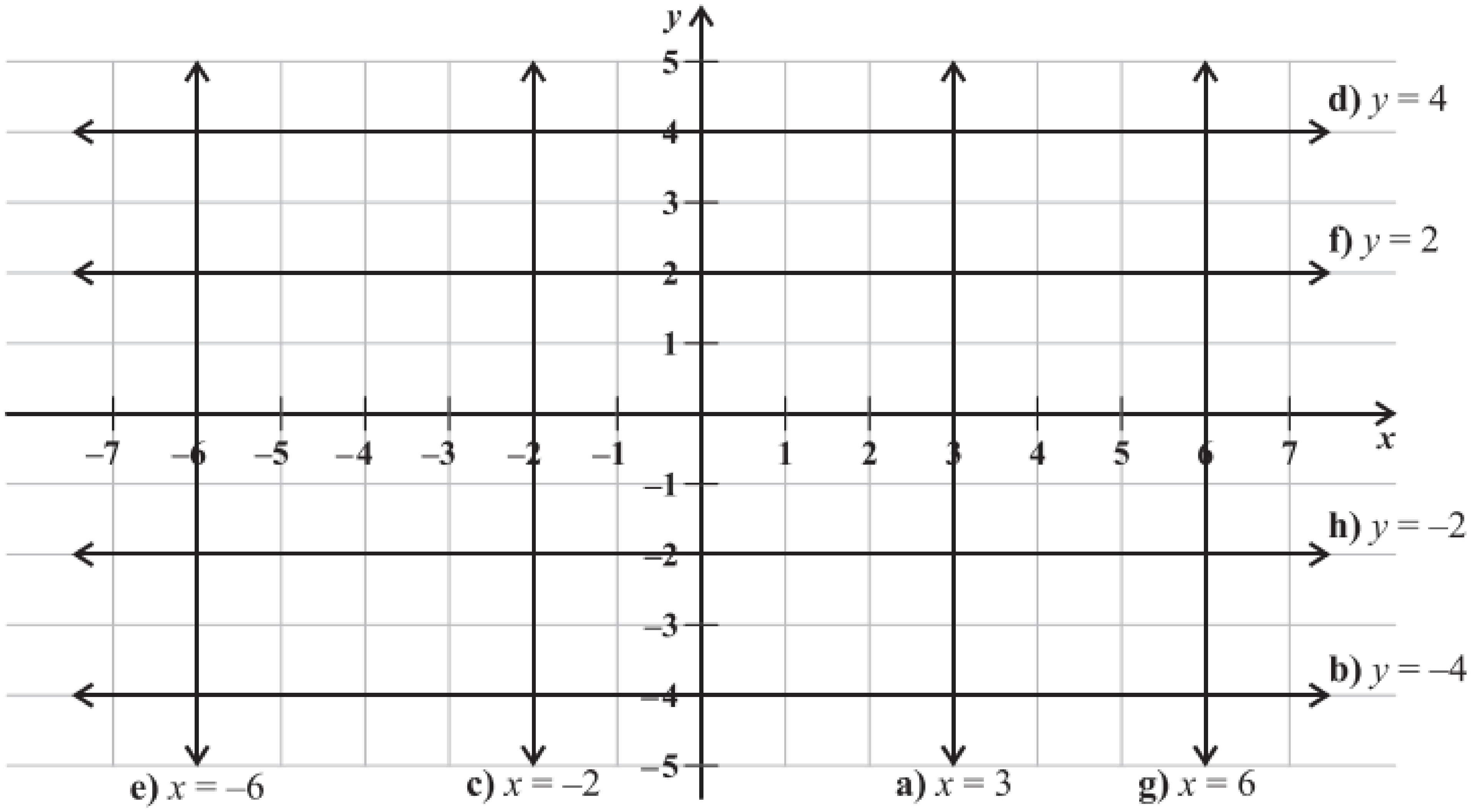
b) Equation **2**

c) Increasing

Exercise 1 number 2 is on page **350**

Exercise 2 Solutions:

1)



Exercise 2 number 1 is on page **350**

2)

a) $x = -4$

b) $y = -4$

c) $x = 2$

d) $y = -2$

e) $x = -7$

f) $y = 1$

g) $x = 5$

h) $y = 2$

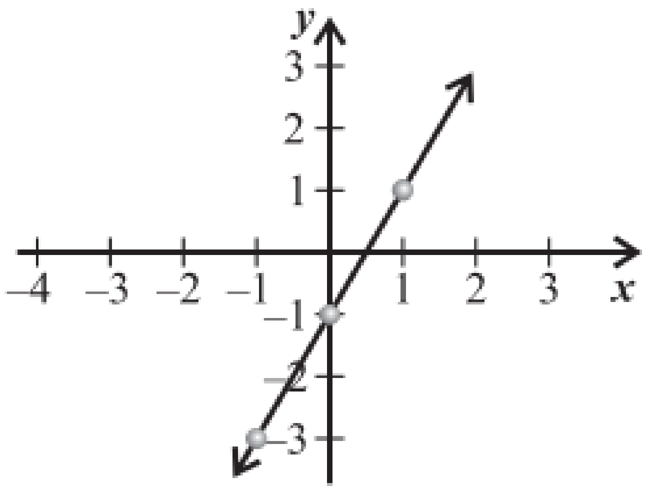
Exercise 2 number 2 is on page **351**

Exercise 3 Solutions:

1)

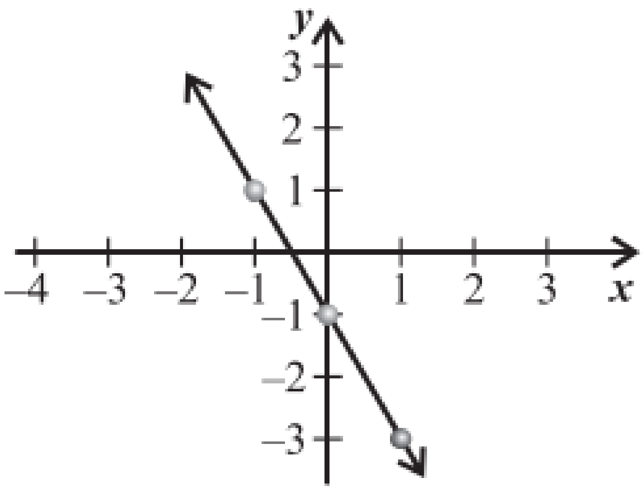
a) $y = 2x - 1$

x	–1	0	1
y	–3	–1	1



b) $y = -2x - 1$

x	–1	0	1
y	1	–1	–3



Exercise 3 number 1 is on page **351** Solutions are continued on the next page

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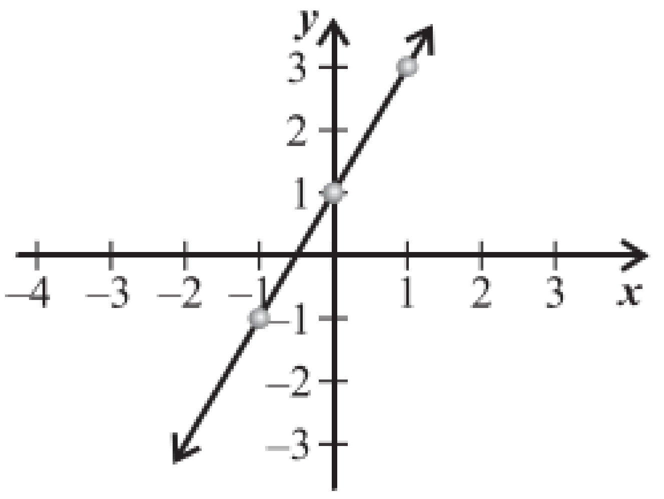
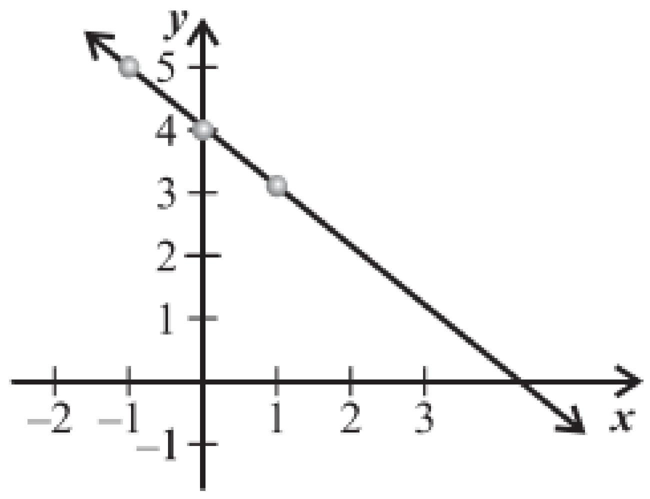
c) $y = 2x + 1$

x	−1	0	1
y	−1	1	3



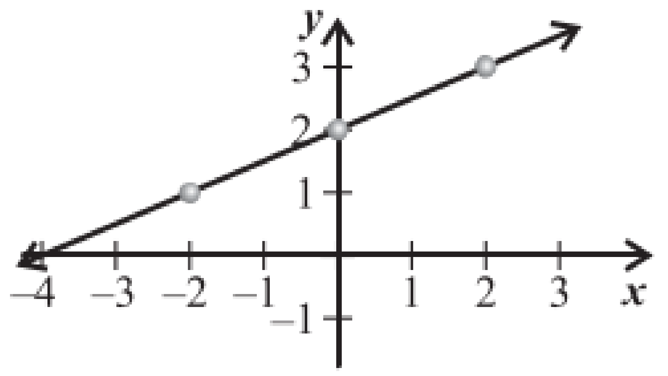
e) $y = -x + 4$

x	−1	0	1
y	5	4	3



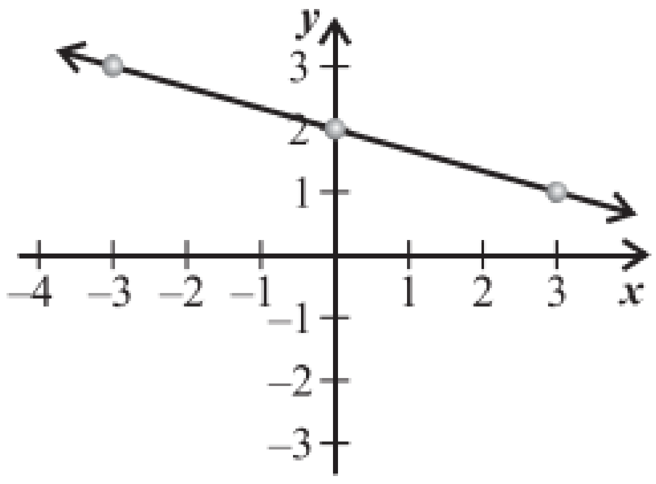
d) $y = \frac{1}{2}x + 2$

x	−2	0	2
y	1	2	3



f) $y = -\frac{x}{3} + 2$

x	−3	0	3
y	3	2	1



Exercise 3 number 1 is on page **351**

2)

a) x-int: let $y = 0$

$0 = \frac{2}{3}x + 2$

$\therefore -\frac{2}{3}x = 2$

$\therefore -2x = 6$

$\therefore x = -3$

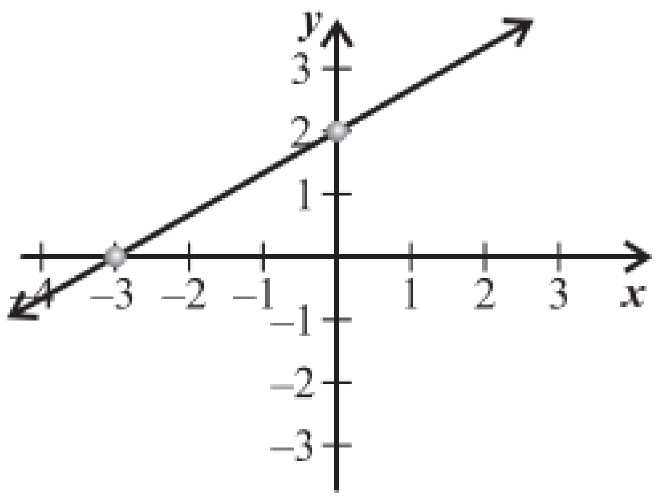
$\therefore x - \text{int} : (-3;0)$

y-int: let $x = 0$

$y = \frac{2}{3}(0) + 2$

$\therefore y = 2$

$\therefore y - \text{int} : (0;2)$



b) x-int: let $y = 0$

$0 = -x + 1$

$\therefore x = 1$

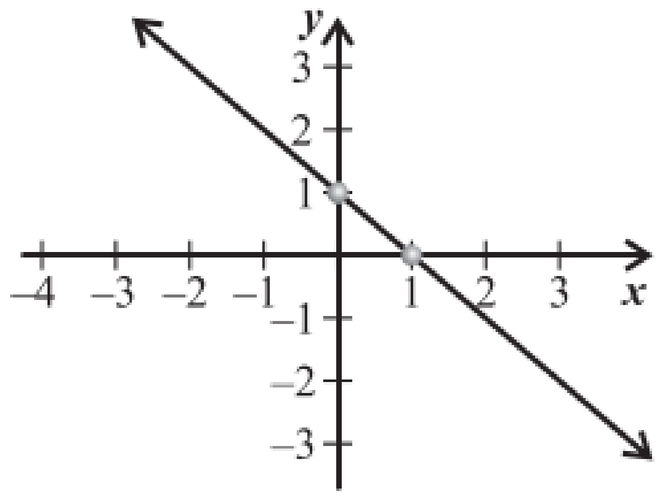
$\therefore x - \text{int} : (1;0)$

y-int: let $x = 0$

$y = 1(0) + 1$

$\therefore y = 1$

$\therefore y - \text{int} : (0;1)$



c) x-int: let $y = 0$

$0 = -x - 3$

$\therefore x = -3$

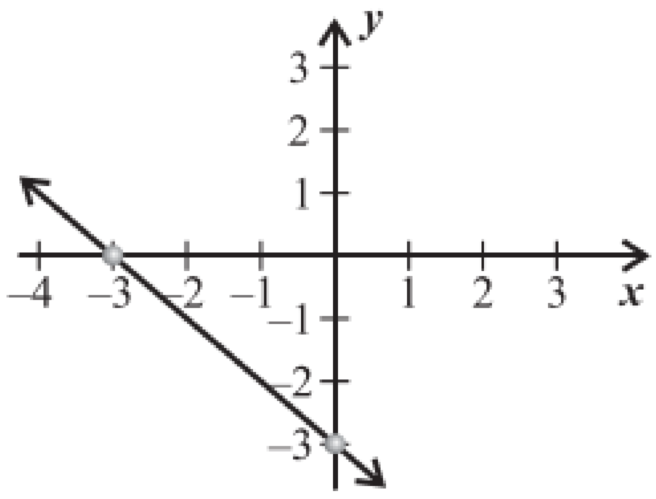
$\therefore x - \text{int} : (-3;0)$

y-int: let $x = 0$

$y = -(0) - 3$

$\therefore y = -3$

$\therefore y - \text{int} : (0;-3)$



d) x-int: let $y = 0$

$0 = -\frac{1}{2}x - 1$

$\therefore \frac{1}{2}x = -1$

$\therefore x = -2$

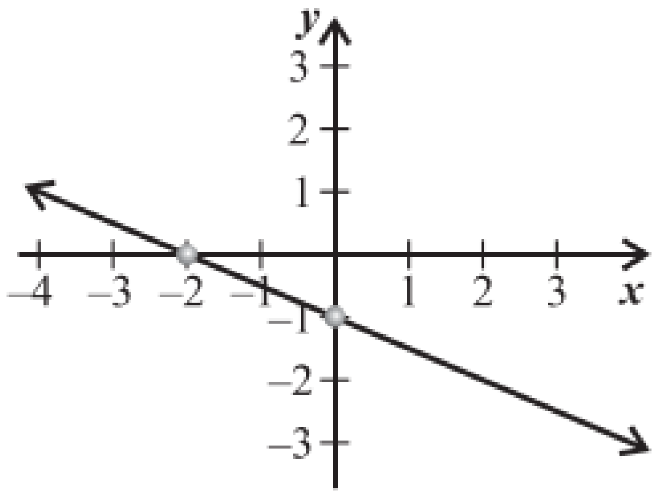
$\therefore x - \text{int} : (-2;0)$

y-int: let $x = 0$

$y = -\frac{1}{2}(0) - 1$

$\therefore y = -1$

$\therefore y - \text{int} : (0;-1)$



Exercise 3 number 2 is on page **351** Solutions are continued on the next page

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e) x-int: let $y = 0$

$0 = -\frac{4}{3}x + 4$

$\therefore \frac{4}{3}x = 4$

$\therefore 4x = 12$

$\therefore x = 3$

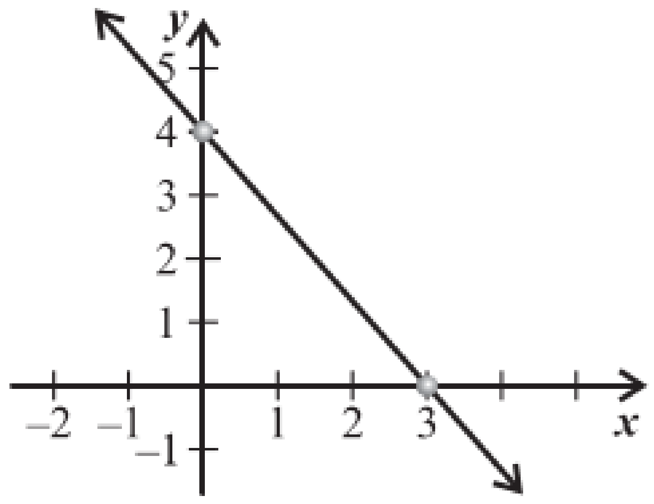
$\therefore x - \text{int} : (3;0)$

y-int: let $x = 0$

$y = -\frac{4}{3}(0) + 4$

$\therefore y = 4$

$\therefore y - \text{int} : (0;4)$



f) x-int: let $y = 0$

$0 = x + 2$

$\therefore -x = 2$

$\therefore x = -2$

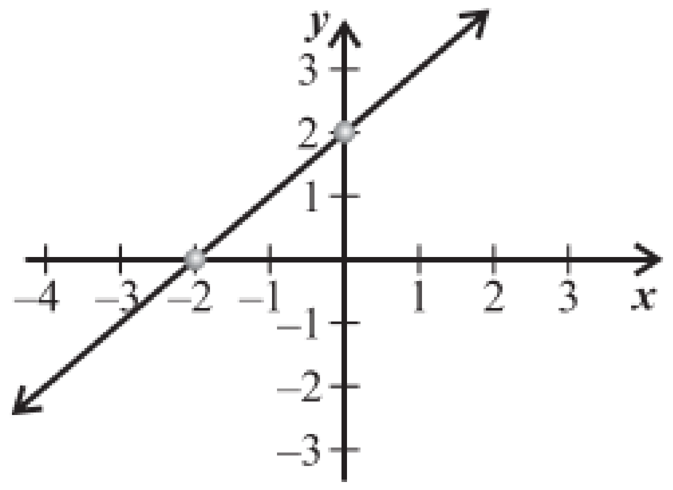
$\therefore x - \text{int} : (-2;0)$

y-int: let $x = 0$

$y = (0) + 2$

$\therefore y = 2$

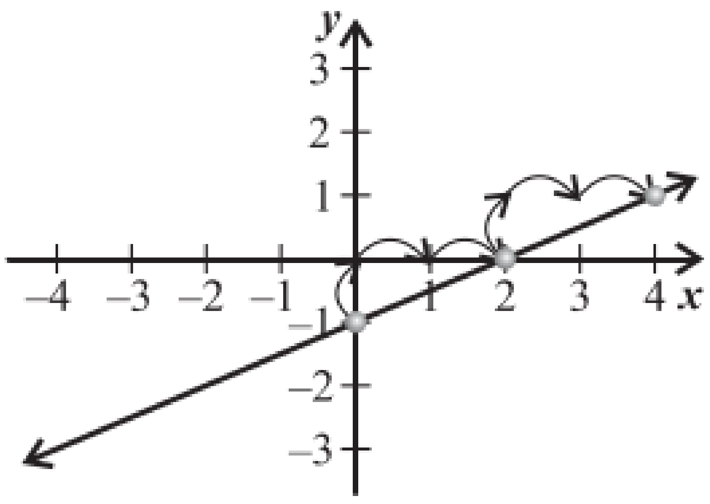
$\therefore y - \text{int} : (0;2)$



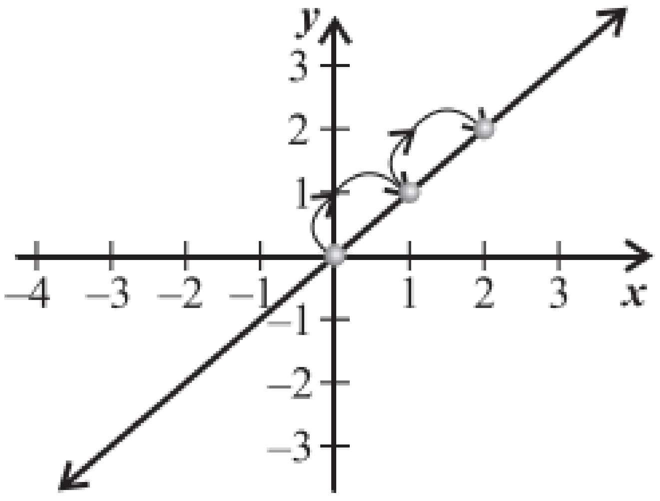
Exercise 3 number 2 is on page **351**

3)

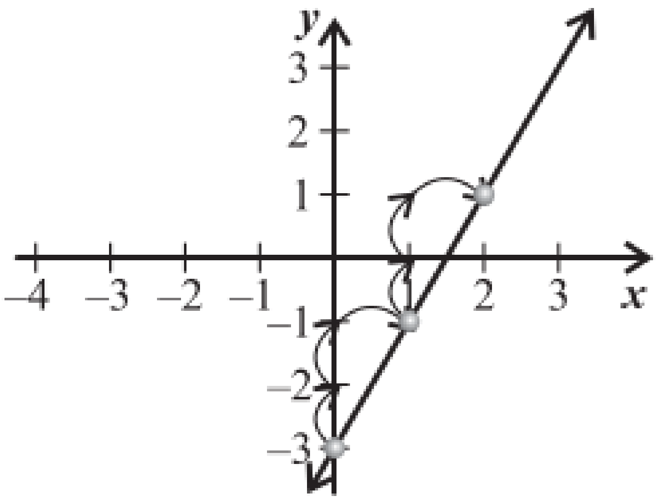
a)



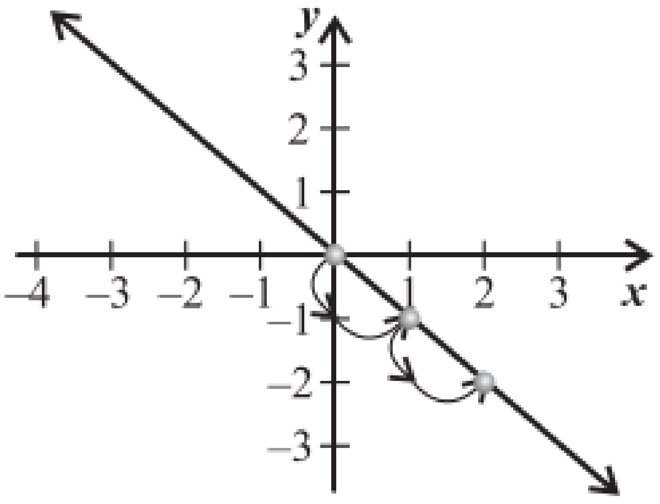
d)



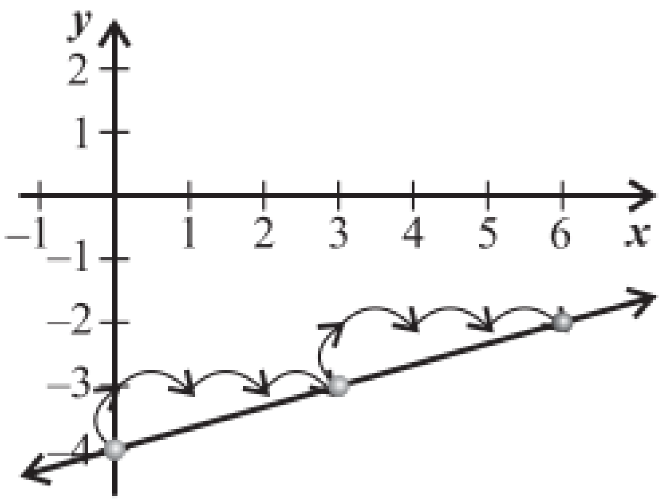
b)



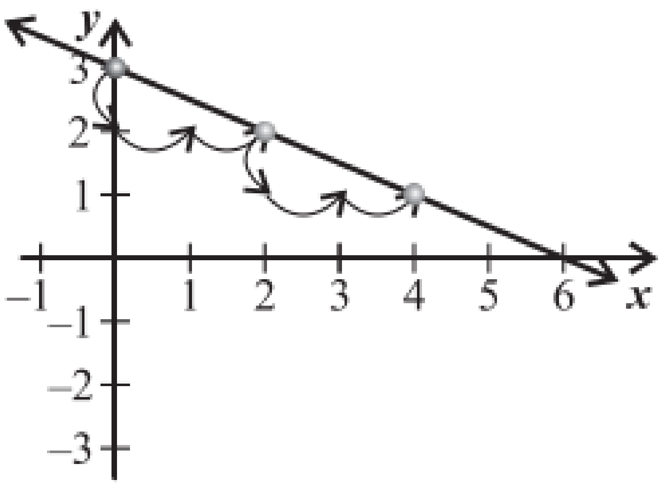
e)



c)



f)



Exercise 3 number 3 is on page **351**

Exercise 4 Solutions:

1) $D \rightarrow m = \frac{5-6}{-2-3} = \frac{-1}{-5} = \frac{1}{5}$

Exercise 4 number 1 is on page **351**

2)

a) $m = \frac{-4-10}{0-3}$

$= \frac{-14}{-3}$

$= \frac{14}{3}$

b) $m = \frac{-4-10}{0-(-3)}$

$= \frac{-14}{+3}$

$= -\frac{14}{3}$

c) $m = \frac{12}{3}$

$= 4$

Exercise 4 number 2 is on page **352**

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d) $m = \frac{4-0}{4-0}$
$= 1$

e) $m = \frac{-10-8}{1-(-3)}$
$= \frac{-18}{4}$
$= -\frac{9}{2}$

f) $m = \frac{-4}{12}$
$= -\frac{1}{3}$

Exercise 4 number 2 is on page **352**

3)

a) $y = 2x - 1$
$\therefore m = 2$

b) $2y + 3 = 2x + 5$
$\therefore 2y = 2x + 2$
$\therefore y = x + 1$
$\therefore m = 1$

c) $3y + 2x - 10 = 0$
$\therefore 3y = -2x + 10$
$\therefore y = -\frac{2}{3}x + \frac{10}{3}$
$\therefore m = -\frac{2}{3}$

d) $5y = 10 - 15x$
$\therefore y = 2 - 3x$
$\therefore m = -3$

e) $3y + 2 = x$
$\therefore 3y = x - 2$
$\therefore y = \frac{1}{3}x - \frac{3}{2}$
$\therefore m = \frac{1}{3}$

f) $8y - 5x + 102 = 5$
$\therefore 8y = 5x - 97$
$\therefore y = \frac{5}{8}x - \frac{97}{8}$
$\therefore m = \frac{5}{8}$

g) $2y + 10x = 1032545$
$\therefore 2y = -10x + 1032545$
$\therefore y = -5x + 516272,5$
$\therefore m = -5$

h) $y = 0x + 10$
$m = 0$

i) $y = -5$
$\therefore y = 0x - 5$
$\therefore m = 0$

Exercise 4 number 3 is on page **352**

4)

a) $m = \frac{2-3}{-3-5} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{1}{8}$

b) $m = \frac{-30+5}{-20+10} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{5}{2}$

c) $m = \frac{-3-4}{4+4} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= -\frac{7}{8}$

d) $m = \frac{2-2}{255+7} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= 0$

e) $m = \frac{3+12}{4+10} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{15}{14}$

f) $m = \frac{5-12}{2-2} \to \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{-7}{0}$
$\therefore$ the gradient is undefined (this is a vertical line)

Exercise 4 number 4 is on page **352**

5) $m_{AB} = \frac{y_2 - y_1}{x_2 - x_1}$
$\therefore 2 = \frac{y-8}{3+5}$
$\therefore 2 = \frac{y-8}{8}$
$\therefore 16 = y - 8$
$\therefore 24 = y$
$\therefore y = 24$

Exercise 4 number 5 is on page **352**

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Exercise 5 Solutions:

1)

a) $y = mx + 8$

$m = \frac{8-0}{0-6} = -\frac{4}{3}$

$\therefore y = -\frac{4}{3}x + 8$

b) $m = \frac{3+6}{12+15} = \frac{1}{3}$

$\therefore y = \frac{1}{3}x + c \rightarrow \text{sub } (12;3)$

$\therefore 3 = \frac{1}{3}(12) + c$

$\therefore c = -1$

$\therefore y = \frac{1}{3}x - 1$

c) $y = mx + 0$

$m = \frac{-10-0}{-8-0} = \frac{5}{4}$

$\therefore y = \frac{5}{4}x$

d) $m = \frac{-20-20}{15+10} = -\frac{8}{5}$

$\therefore y = -\frac{8}{5}x + c \rightarrow \text{sub } (-20;15)$

$\therefore -20 = -\frac{8}{5}(15) + c$

$\therefore c = 4$

$\therefore y = -\frac{8}{5}x + 4$

e) $y = mx + 12$

$m = \frac{12-0}{0+6} = 2$

$\therefore y = 2x + 12$

f) $m = \frac{-2-2}{2+3} = -\frac{4}{5}$

$\therefore y = -\frac{4}{5}x + c \rightarrow \text{sub } (2;-2)$

$\therefore -2 = -\frac{4}{5}(2) + c$

$\therefore c = -\frac{2}{5}$

$\therefore y = -\frac{4}{5}x - \frac{2}{5}$

Exercise 5 number 1 is on page 352

2)

a) $m = \frac{-3-3}{-4-2} = 1$

$\therefore y = x + c \rightarrow \text{sub } (2;3)$

$\therefore 3 = 1(2) + c$

$\therefore c = 1$

$\therefore y = x + 1$

b) $m = \frac{8+13}{-1-6} = -3$

$\therefore y = -3x + c \rightarrow \text{sub } (-1;8)$

$\therefore 8 = -3(-1) + c$

$\therefore c = 5$

$\therefore y = -3x + 5$

c) $m = \frac{-23-12}{3+4} = -5$

$\therefore y = -5x + c \rightarrow \text{sub } (-4;12)$

$\therefore 12 = -5(-4) + c$

$\therefore c = -8$

$\therefore y = -5x - 8$

Exercise 5 number 2 is on page 353

Exercise 6 Solutions:

1)

a) $y = -3x + 5$

b) $y = -5x + c \rightarrow \text{sub P}(8;3)$

$\therefore 3 = -5(8) + c$

$\therefore c = 43$

$\therefore y = -5x + 43$

c) $y = \frac{2}{3}x + c \rightarrow \text{sub C}(9;-2)$

$\therefore -2 = \frac{2}{3}(9) + c \rightarrow \text{sub C}(9;-2)$

$\therefore c = -8$

$\therefore y = \frac{2}{3}x - 8$

d) $y = -3$

Exercise 6 number 1 is on page 353

2)

a) $y = -2x + c \rightarrow \text{sub } (-3;-3)$

$\therefore -3 = -2(-3) + c$

$\therefore c = -9$

$\therefore y = -2x - 9$

b) $y = \frac{1}{2}x + c \rightarrow \text{sub } (-7;-3)$

$\therefore -7 = \frac{1}{2}(-3) + c$

$\therefore c = -\frac{11}{2}$

$\therefore y = \frac{1}{2}x - \frac{11}{2}$

c) $y = \frac{1}{2}x + 0$

Exercise 6 number 2 is on page 353

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Mixed Exercise Solutions:

1)

A	3	**D**	6
B	5	**E**	1
C	4	**F**	2

The Mixed Exercise number 1 is on page **353**

2)

a) False, the gradient is –5.

b) False, the gradient is $\dfrac{4+5}{-3-8}$

c) True

d) True

The Mixed Exercise number 1 is on page **354**

3) Substitute (b ; –5) into $y = -3x + 10$:

$\therefore -5 = -3b + 10$

$\therefore 3b = 15$

$\therefore b = 5$

The Mixed Exercise number 3 is on page **354**

4) Substitute (3 ; p) into $y = 8x - 4$:

$\therefore p = 8(3) - 4$

$\therefore p = 20$

The Mixed Exercise number 4 is on page **354**

5) Substitute $x = 3$ into $y = 2x - 6$

$\therefore y = 2(3) - 6$

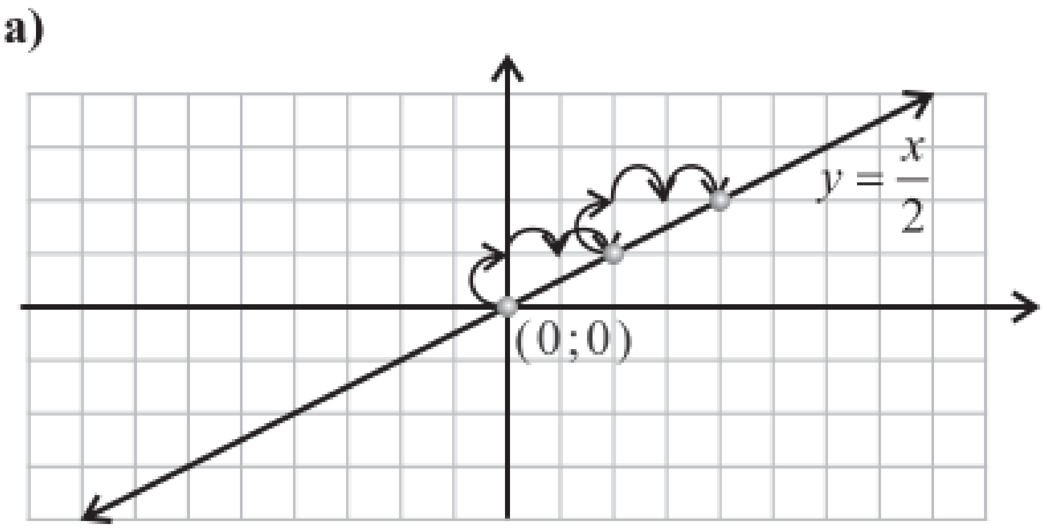
$= 0$

Therefore, Q does not lie on the line as when $x = 3$ the y-value must equal 0 to lie on the line.

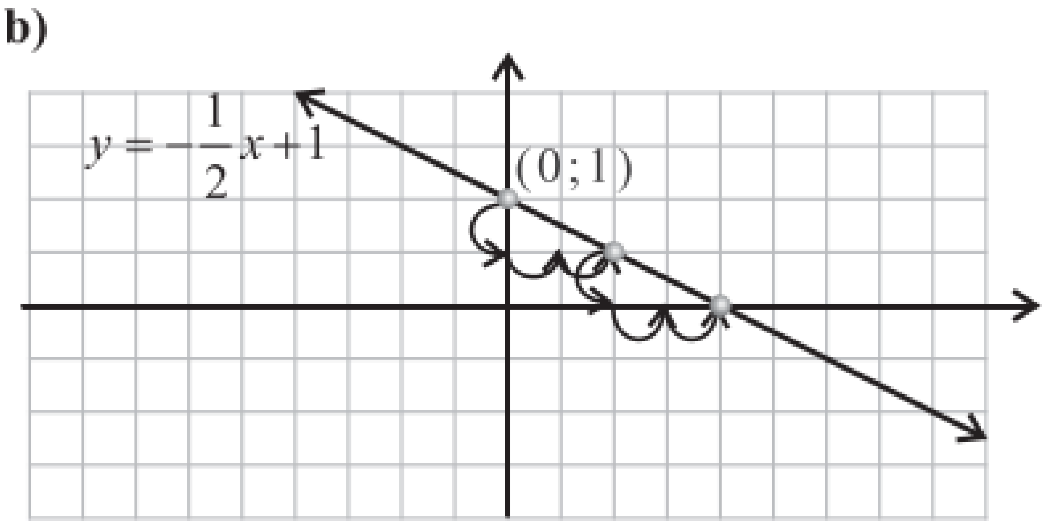
The Mixed Exercise number 5 is on page **354**

6) Any method can be used. The graphs below were sketched using the gradient intercept method:

a)



b)



The Mixed Exercise number 6 is on page **354**

7)

a) $m = \dfrac{4-8}{0-5} = \dfrac{4}{5}$

$\therefore y = \dfrac{4}{5}x + 4 \rightarrow (0;4)$ is the y-int

b) $m = \dfrac{8-0}{1-2} = -8$

$\therefore y = -8x + c \rightarrow$ sub in $(2;0)$

$\therefore 0 = -8(2) + c$

$\therefore c = 16$

$\therefore y = -8x + 16$

The Mixed Exercise number 7 is on page **354**

8)

a) $2y = -3x + 5$

$\therefore y = -\dfrac{3}{2}x + \dfrac{5}{2}$

$m = -\dfrac{3}{2}$ and y-int is $\left(0;\dfrac{5}{2}\right)$

b) $4y = -2x + 3$

$\therefore y = -\dfrac{1}{2}x + \dfrac{3}{4}$

$m = -\dfrac{1}{2}$ and y-int is $\left(0;\dfrac{3}{4}\right)$

c) $6y - 16x + 5 = 2x + 6$

$6y = 18x + 1$

$\therefore y = 3x + \dfrac{1}{6}$

$m = 3$ and y-int is $\left(0;\dfrac{1}{6}\right)$

The Mixed Exercise number 8 is on page **354**

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9)

a) PQ:

$$m=\frac{-1-(-3)}{-4-(-8)}=\frac{1}{2}$$

$$\therefore y=\frac{1}{2}x+c \rightarrow \text{sub } (-4;-1)$$

$$\therefore -1=\frac{1}{2}(-4)+c$$

$$\therefore c=1$$

$$\therefore y=\frac{1}{2}x+1$$

RS:

$$m=\frac{3-0}{0-3}=-1$$

$$\therefore y=-x+3$$

b) Sub $(4;a)$ into $y=\frac{1}{2}x+1$:

$$\therefore a=\frac{1}{2}(4)+1$$

$$\therefore a=3$$

Sub $(4;b)$ into $y=-x+3$:

$$\therefore b=-(4)+3$$

$$\therefore b=-1$$

c) AB = 3 + 1
= 4 units

The Mixed Exercise number 9 is on page **354**

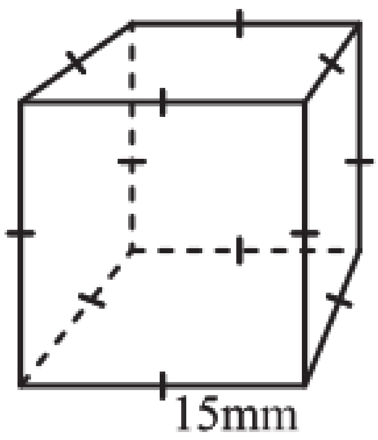
Chapter 17 - Surface Area and Volume

Grade 8 revision (from page 179 - 184)

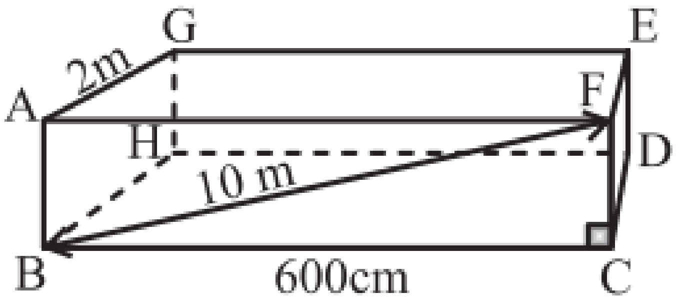
Exercise 1:

1) Determine the surface area and volume of the rectangular prisms shown below:

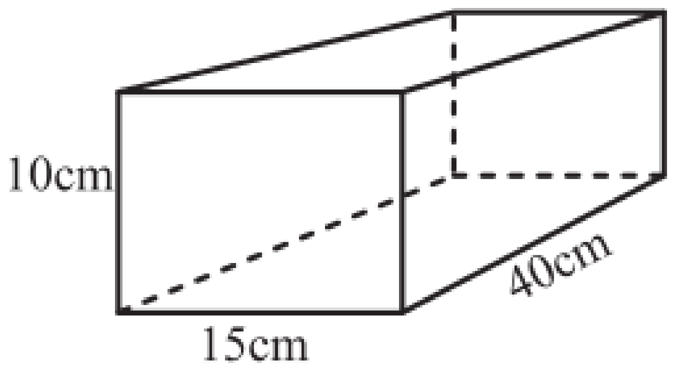
a)



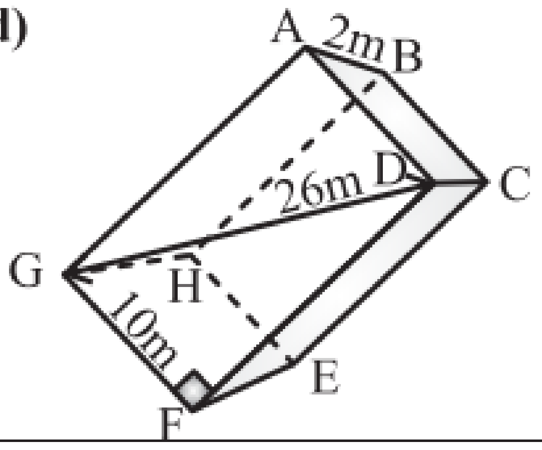
b)



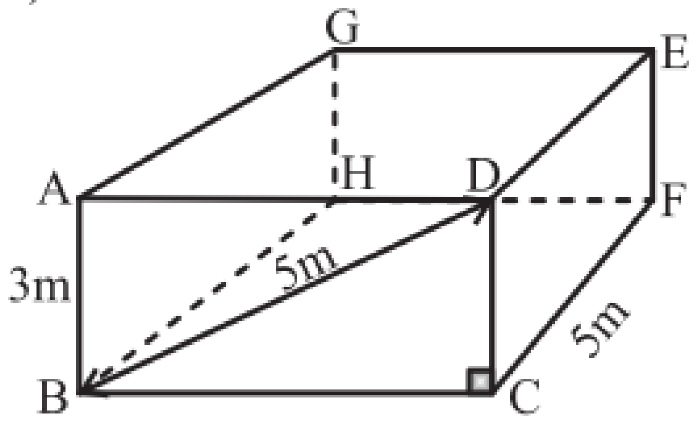
c)



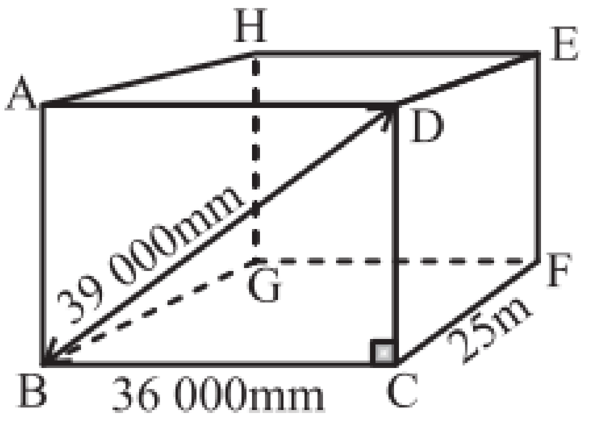
d)



e)



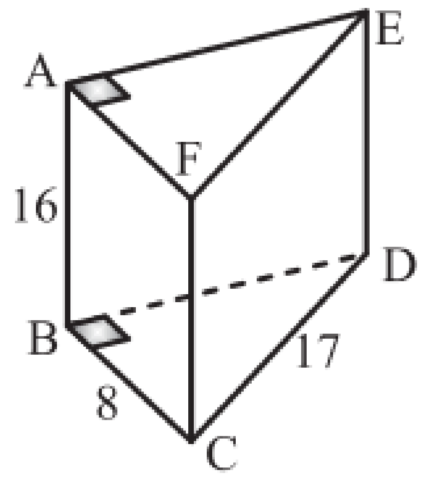
f)



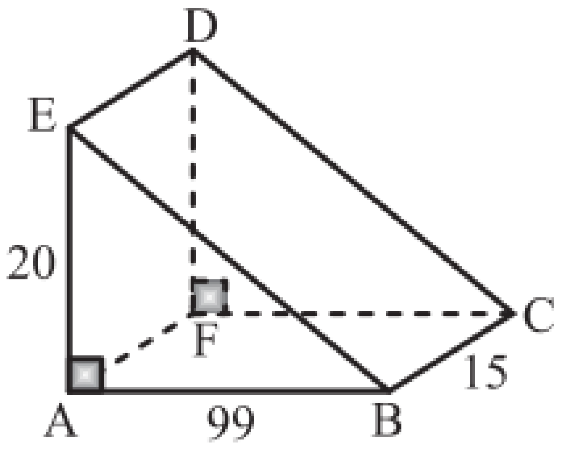
Solutions to Exercise 1 number 1 are on page **365**

2) Determine the surface area and volume of the rectangular prisms shown below. All dimensions are in metres.

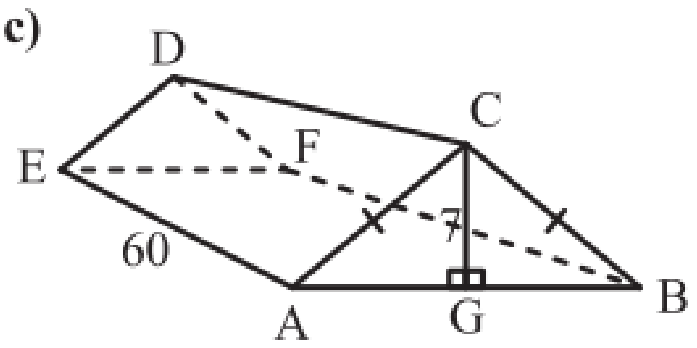
a)



b)

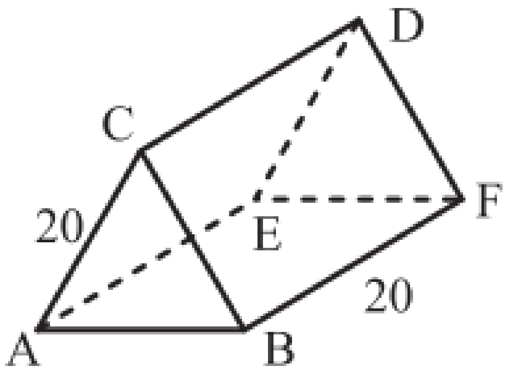


c)



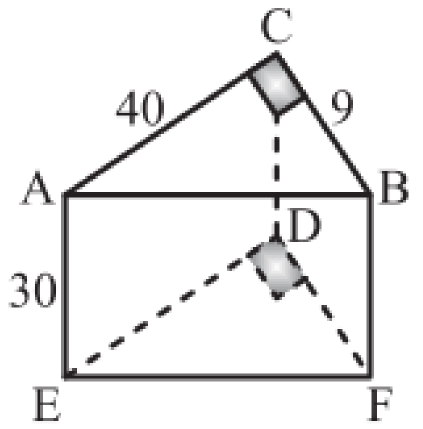
AB = 48m and CG = 7m

d)

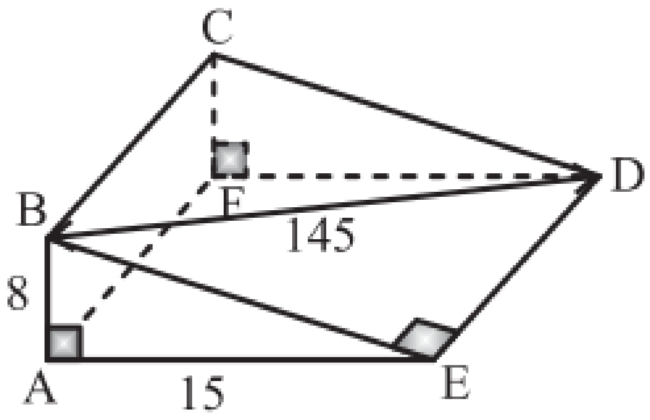


Triangle ABC is equilateral

e)

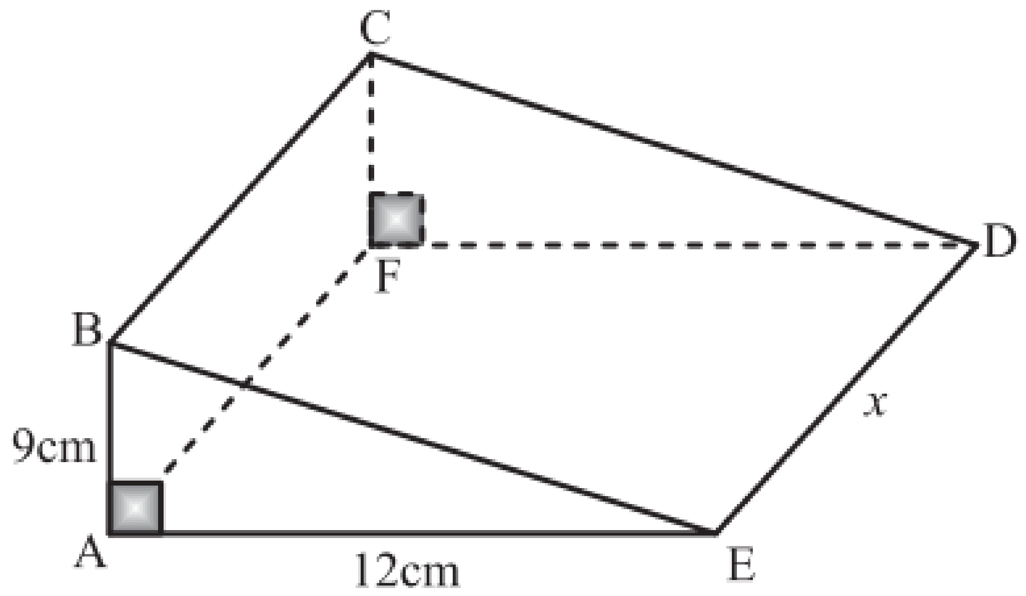


f)



Solutions to Exercise 2 number 1*a* to *d* are on page **365** and *e* to *f* are on page **366**

3) The Prism below has a surface area of 468cm^2. Determine the value of x.



Solutions to Exercise 2 number 3 are on page **366**

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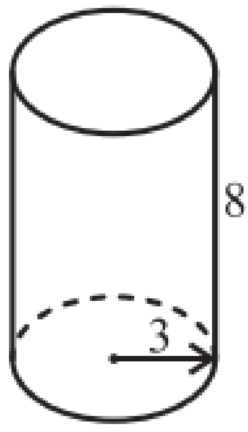
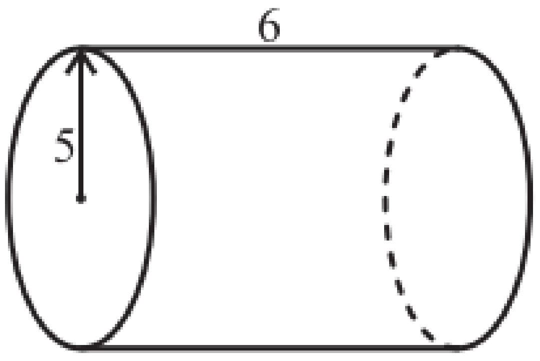
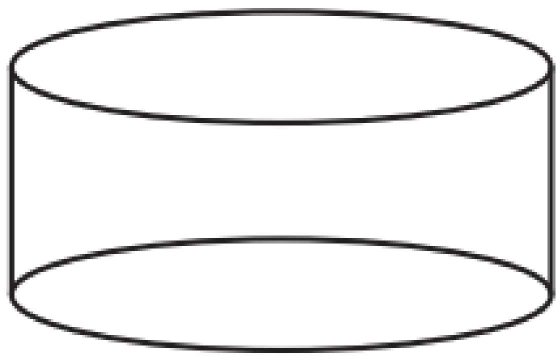
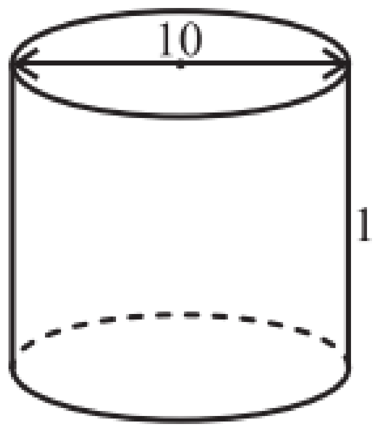
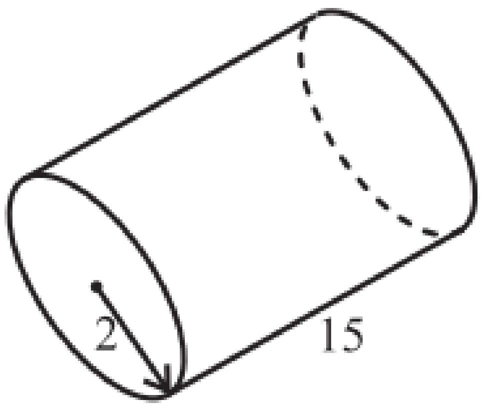
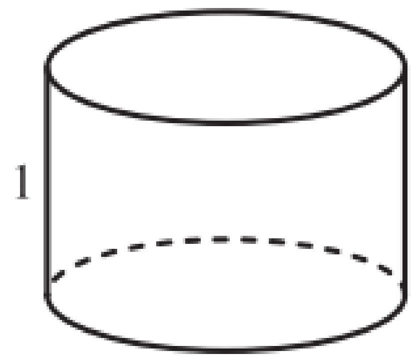
The Cylinder (from page 185 - 187)

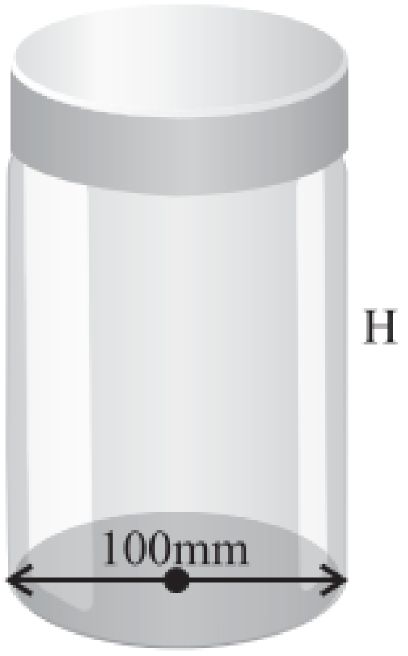
Exercise 2:

1) Determine the surface area and volume of the cylinders shown below. All dimensions are in metres.

a)  Cylinder is closed on both ends	**c)**  Cylinder is open on both ends	**e)**  Cylinder is open on one end and has a circumference of 10π
b)  Cylinder is closed on one end	**d)**  Cylinder is closed on both ends	**f)**  Cylinder is closed on both ends and has a circumference of 2π

Solutions to Exercise 1 number 1 are on page **366**

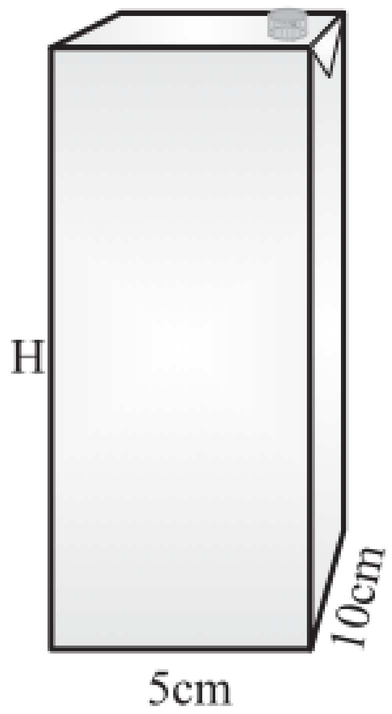
2) The glass jar below has a volume of 1 litre. Determine the height of the jar.

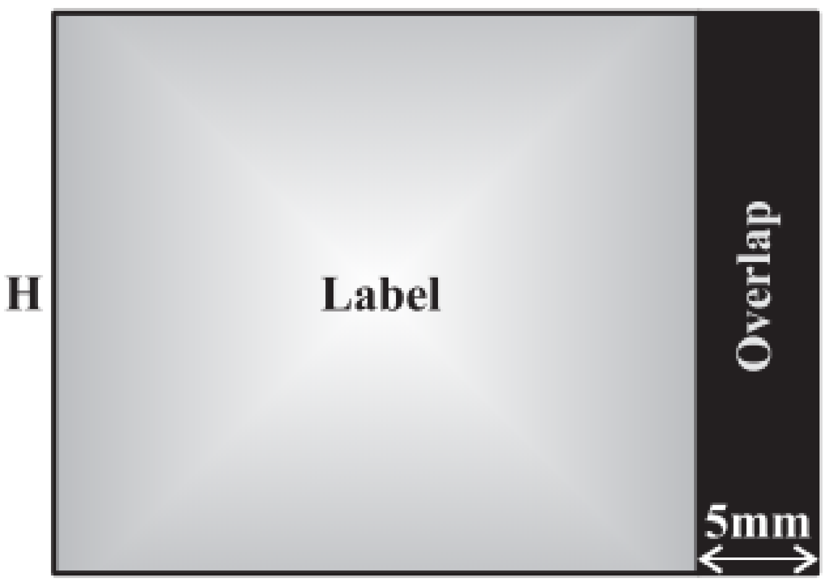


Solutions to Exercise 1 number 2 are on page **367**

Mixed Exercise:

1) A fruit juice manufacturer is changing its design from a rectangular carton to a cylinder of the same height. The original carton has a volume of 900ml. The diagram below shows the company's original rectangular carton and the design for the new cylindrical carton.





a) Determine the height and radius of the cylindrical container if both containers are to hold the same volume.

b) The manufacturer wishes to place a label around the cylinder. To stick the label together, it is required that there is a 5mm overlap on the label. Determine the dimensions of the label.

c) The labels are printed on sheets of paper which are 1m wide and 2m in length. How many sheets of paper are required to print 2 000 labels?

Solutions to the Mixed Exercise number 1 are on page **367**

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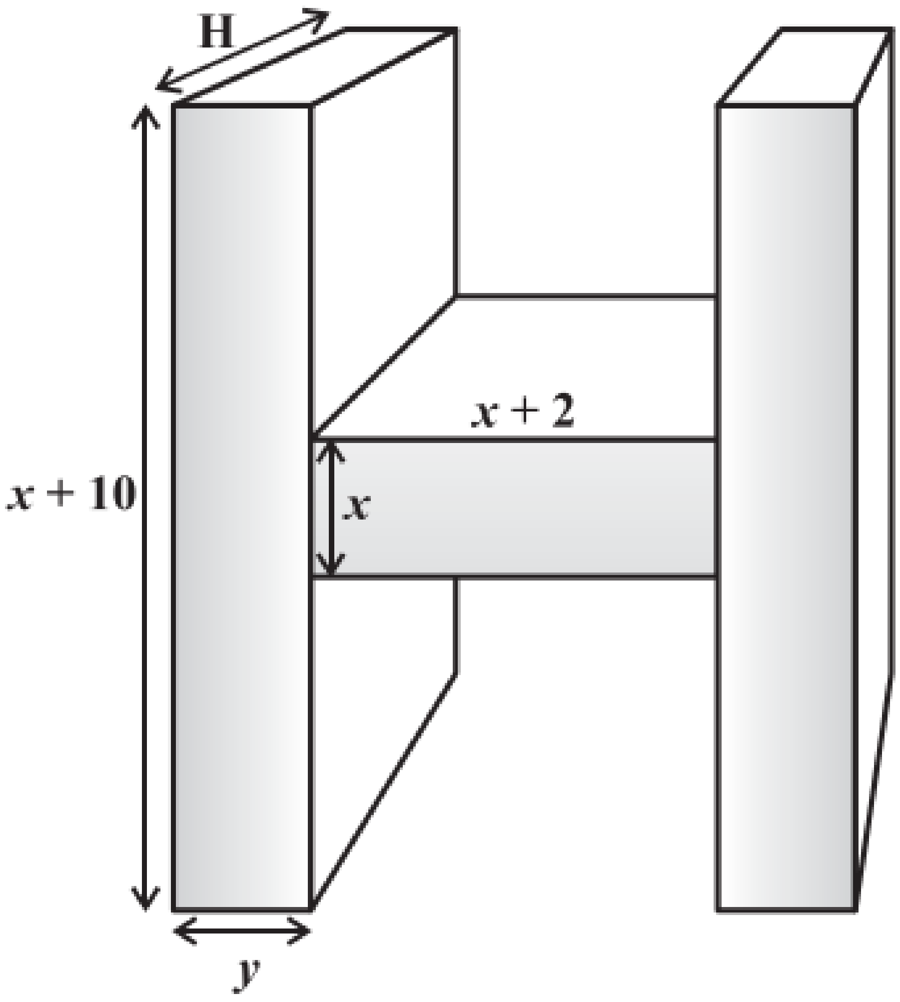
2) A sign manufacturer is constructing the letter H for a hotel. The front of the H, which is shaded in the diagram, is made up of a panel of lights to make the sign visible at night.

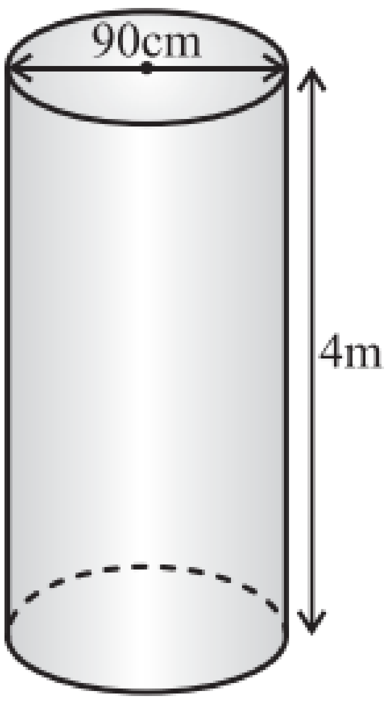


a) Determine the surface area of the light panel (the shaded region). Give your answer in terms of x and y.

b) If the volume of the sign is $8x^2y + 4x^3 + 8x^2 + 80xy$, determine the value of H in the diagram. Give your answer in terms of x.

Solutions to the Mixed Exercise number 2 are on page **367**

3) In 2016 and 2017 South Africa experienced one of the worst droughts on record since 1904. To save water Seraphina decides to build a rainwater storage tank out of steel sheeting. The tank will have a diameter of 90 centimetres and a height of 4 metres. The tank is filled by a pipe which collects rainwater from the roof of Seraphina's house and is closed on both ends.



a) Determine the exterior surface area of the tank.

b) Seraphina would like to paint the outside of her tank. She decides to use a paint which can cover $1{,}5\text{m}^2$ per tin. If each tin costs R150, how much would it cost to paint the tank?

c) Determine the volume of the tank in millilitres.

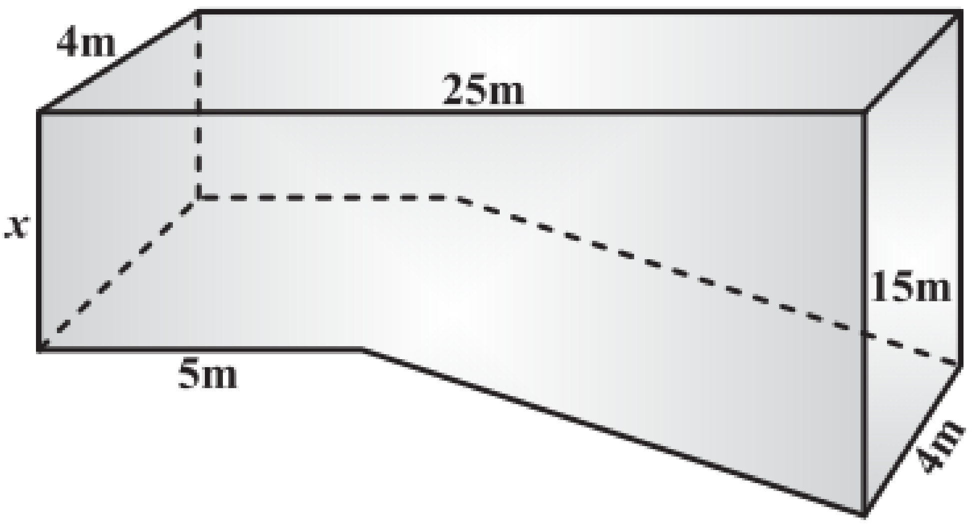
d) In a large rainstorm, the tank fills at a rate of 1 500ml per minute. How long would the storm need to last to fill the tank. Give your answer to the nearest minute.

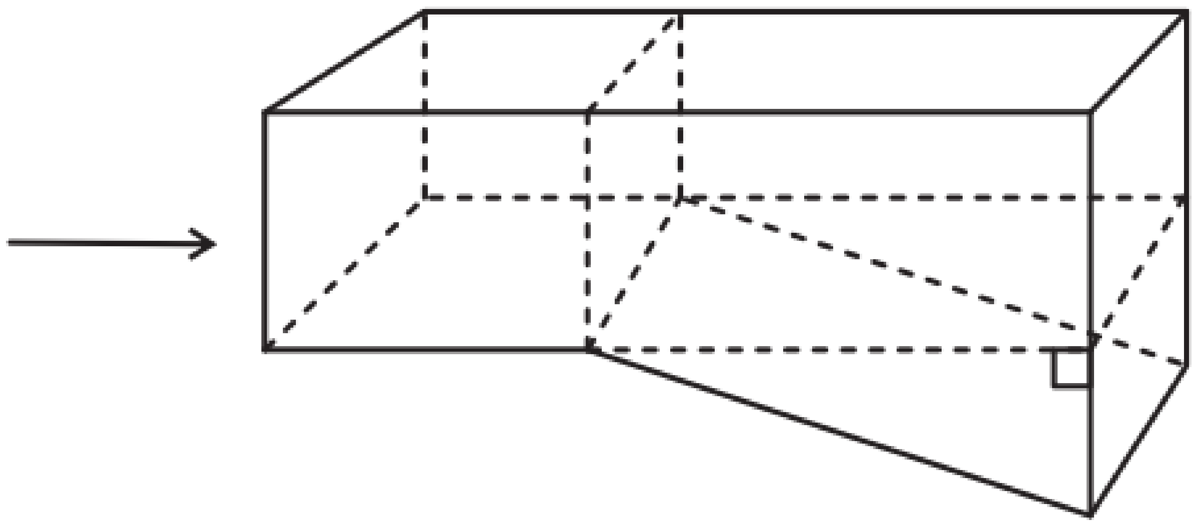
e) A friend suggests to Seraphina that if she doubles the radius of the tank she will double the volume that the tank can hold. Is her friend correct? Give a reason for your answer.

f) What single change could Seraphina make to the tank to double its volume?

Solutions to the Mixed Exercise number 3 are on page **367**

4) A scuba diving training centre uses the pool shown below to train new divers. It has a shallow end which is x metres deep and 5 metres long. The deep end is 15 metres deep and the pool is 4 metres wide.





a) Determine the volume of the swimming pool in terms of x.

b) If the swimming pool can hold 900 kilolitres of water, determine the value of x.

Solutions to the Mixed Exercise number 4 are on page **368**

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Chapter 17 - Surface Area and Volume (Solutions)

Exercise 1 Solutions:

1)

a) $SA = 6(15^2)$

$= 1350\,mm^2$

$V = 15^3$

$= 3375\,mm^3$

b) $CF^2 = 10^2 - 6^2 \rightarrow$ pythag, $600cm = 6m$

$= 64$

$\therefore CF = 8\,m$

$SA = 2(6\times 8) + 2(6\times 2) + 2(2\times 8)$

$= 152\,m^2$

$V = 6\times 8\times 2$

$= 96\,m^3$

c) $SA = 2(10\times 15) + 2(15\times 40) + 2(10\times 40)$

$= 2300\,cm^2$

$V = 10\times 15\times 40$

$= 6000\,cm^3$

d) $FD^2 = 26^2 - 10^2 \rightarrow$ pythag

$= 576$

$\therefore FD = 24\,m$

$SA = 2(10\times 24) + 2(2\times 24) + 2(10\times 2)$

$= 616\,m^2$

$V = 10\times 24\times 2$

$= 480\,m^3$

e) $AD^2 = 5^2 - 3^2 \rightarrow$ pythag

$= 16$

$\therefore AD = 4\,m$

$SA = 2(3\times 4) + 2(3\times 8) + 2(4\times 5)$

$= 112\,m^2$

$V = 3\times 4\times 5$

$= 60\,m^3$

f) $CD^2 = 39^2 - 36^2 \rightarrow$ pythag

$= 225$

$\therefore CD = 15\,m$

$SA = 2(36\times 15) + 2(15\times 25) + 2(36\times 25)$

$= 3630\,m^2$

$V = 36\times 15\times 25$

$= 13500\,m^3$

Exercise 1 number 1 is on page **362**

2)

a) $AE^2 = 17^2 - 8^2 \rightarrow$ pythag

$= 225$

$\therefore AE = 15\,m$

$SA = 2\left(\frac{1}{2}\times 15\times 8\right) + (16\times 8) + (17\times 16) + (16\times 15)$

$= 760\,m^2$

$V = \left(\frac{1}{2}\times 15\times 8\right)(16)$

$= 960\,m^3$

b) $EB^2 = 20^2 + 99^2 \rightarrow$ pythag

$= 10201$

$\therefore CF = 101\,m$

$SA = 2\left(\frac{1}{2}\times 20\times 99\right) + (99\times 15) + (101\times 15) + (20\times 15)$

$= 5280\,m^2$

$V = \left(\frac{1}{2}\times 20\times 99\right)(15)$

$= 14850\,m^3$

c) $AC^2 = 24^2 + 7^2 \rightarrow$ pythag

$= 625$

$\therefore AC = 25\,m$

$SA = 2\left(\frac{1}{2}\times 48\times 7\right) + 2(60\times 25) + (60\times 48)$

$= 6216\,m^2$

$V = \left(\frac{1}{2}\times 48\times 7\right)(60)$

$= 10080\,m^3$

d) $\perp Height^2 = 20^2 - 10^2 \rightarrow$ pythag

$= 300$

$\therefore AC = 10\sqrt{3}\,m$

$SA = 2\left(\frac{1}{2}\times 20\times 10\sqrt{3}\right) + 3(20\times 20)$

$= 1546{,}41\,m^2$

$V = \left(\frac{1}{2}\times 20\times 10\sqrt{3}\right)(20)$

$= 3464{,}1\,m^3$

Exercise 1 number 2 is on page **362.** Solutions are continued on the next page.

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e) $AB^2 = 40^2 + 9^2 \rightarrow \text{pythag}$

$= 1681$

$\therefore AE = 41\,\text{m}$

$SA = 2\left(\frac{1}{2}\times 40\times 9\right)+(9\times 30)+(40\times 30)+(30\times 41)$

$= 3060\,\text{m}^2$

$V = \left(\frac{1}{2}\times 40\times 9\right)(30)$

$= 5\,400\,\text{m}^3$

f) $BE^2 = 8^2 + 15^2 \rightarrow \text{pythag}$

$= 289$

$\therefore BE = 17\,\text{m}$

$DE^2 = 145^2 - 17^2 \rightarrow \text{pythag}$

$= 20\,736$

$\therefore DE = 144\,\text{m}$

$SA = 2\left(\frac{1}{2}\times 8\times 15\right)+(17\times 144)+(15\times 144)+(15\times 8)$

$= 4\,848\,\text{m}^2$

$V = \left(\frac{1}{2}\times 15\times 8\right)(144) \rightarrow \frac{1}{2}(AE)(AB)(DE)$

$= 8\,640\,\text{m}^3$

Exercise 1 number 2 is on page **362**

3) $BE^2 = 9^2 + 12^2$

$= 225$

$\therefore BE = 15\,\text{cm}$

$468 = 2\left(\frac{1}{2}\times 9\times 12\right)+15x+12x+9x$

$\therefore 468 = 108 + 36x$

$\therefore -36x = -360$

$\therefore x = 10\,\text{cm}$

Exercise 1 number 3 is on page **362**

<u>Exercise 2 Solutions</u>:

1)

a) $SA = 2\pi(3)^2 + 2\pi(3)(8)$

$= 207{,}35\,\text{m}^2$

$V = \pi(3)^2(8)$

$= 226{,}19\,\text{m}^3$

b) $SA = \pi(5)^2 + 2\pi(5)(15)$

$= 549{,}78\,\text{m}^2$

$V = \pi(5)^2(15)$

$= 1178{,}1\,\text{m}^3$

c) $SA = 2\pi(5)(6)$

$= 188{,}50\,\text{m}^2$

$V = \pi(5)^2(6)$

$= 471{,}24\,\text{m}^3$

d) $SA = 2\pi(2)^2 + 2\pi(2)(15)$

$= 213{,}63\,\text{m}^2$

$V = \pi(2)^2(15)$

$= 188{,}50\,\text{m}^3$

e) $C = 2\pi r$

$\therefore 10\pi = 2\pi r$

$\therefore r = 5\,\text{m}$

$SA = \pi(5)^2 + 10\pi(3)$

$= 172{,}79\,\text{m}^2$

$V = \pi(5)^2(3)$

$= 235{,}62\,\text{m}^3$

f) $C = 2\pi r$

$\therefore 2\pi = 2\pi r$

$\therefore r = 1\,\text{m}$

$SA = 2\pi(1)^2 + 2\pi(1)$

$= 12{,}57\,\text{m}^2$

$V = \pi(1)^2(1)$

$= 3{,}14\,\text{m}^3$

Exercise 2 number 1 is on page **363**

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2) $V = \pi r^2 H$

$\therefore 1000 = \pi(5)^2 H$

$\therefore H = \dfrac{1000}{25\pi}$

$= 12,73\,\text{cm}$

Exercise 2 number 2 is on page 363

Mixed Exercise Solutions:

1)

a) $V_{\text{rect carton}} = H \times 5 \times 10$

$\therefore 900 = 50H$

$\therefore H = 18\,\text{cm}$

$V_{\text{cyl}} = \pi r^2 H$

$\therefore 900 = \pi r^2 (18)$

$\therefore r^2 = \dfrac{900}{18\pi}$

$\therefore r = 15,92\,\text{cm}$

b) $\text{width} = 2\pi r + 5$

$= 2\pi(15,92) + 5$

$= 105,03\,\text{cm}$

$\therefore$ Width $= 105,03\,\text{cm}$ and Height $= 18\,\text{cm}$

c) Number of labels that can be printed in 1m:

$\dfrac{1000}{18} = 55,56$

Number of labels that can be printed in 2m:

$\dfrac{2000}{105,03} = 19,04$

$\therefore$ Number of labels per roll $= 55 \times 19$

$= 1045$ labels per roll

$\therefore$ 2 sheets would be required to print 2000 labels.

The Mixed Exercise number 1 is on page 363

2)

a) $SA = 2y(x+10) + x(x+2)$

$= 2xy + 20y + x^2 + 2x\ \text{units}^2$

b) To answer this question, you must remember that volume is equal to the height of the shape multiplied by the surface area of the base shape.

Method 1:

$V = 8x^2y + 4x^3 + 8x^2 + 80xy \rightarrow$ factorise

$= 4x\left(2xy + x^2 + 2x + 20y\right)$

$\therefore$ Height $= 4x$ units

Method 2:

$H = \dfrac{8x^2y + 4x^3 + 8x^2 + 80xy}{2xy + 20y + x^2 + 2x}$

$= \dfrac{4x\left(2xy + x^2 + 2x + 20y\right)}{2xy + 20y + x^2 + 2x}$

$= 4x$ units

The Mixed Exercise number 2 is on page 364

3)

a) $SA = 2\pi(0,45)^2 + 2\pi(0,45)(4)$

$= 12,58\,\text{m}^2$

b) Number of tins $= \dfrac{12,58}{1,5}$

$= 8,39$

$\therefore$ 9 tins are required

Cost $= 9 \times 150$

$= \text{R}1350$

c) $V = \pi(45)^2(400)$

$= 2\,544\,690,05\,\text{cm}^3$

$= 2\,544\,690,05\,\text{m}l$

d) Time $= \dfrac{2\,544\,690,05}{1500}$

$= 1696,46$

$= 1696$ minutes $\rightarrow$ answer to the nearest minute

e) She is incorrect. Doubling the radius would increase the volume by a factor of 4.

f) She could double the height of the tank.

The Mixed Exercise number 3 is on page 364

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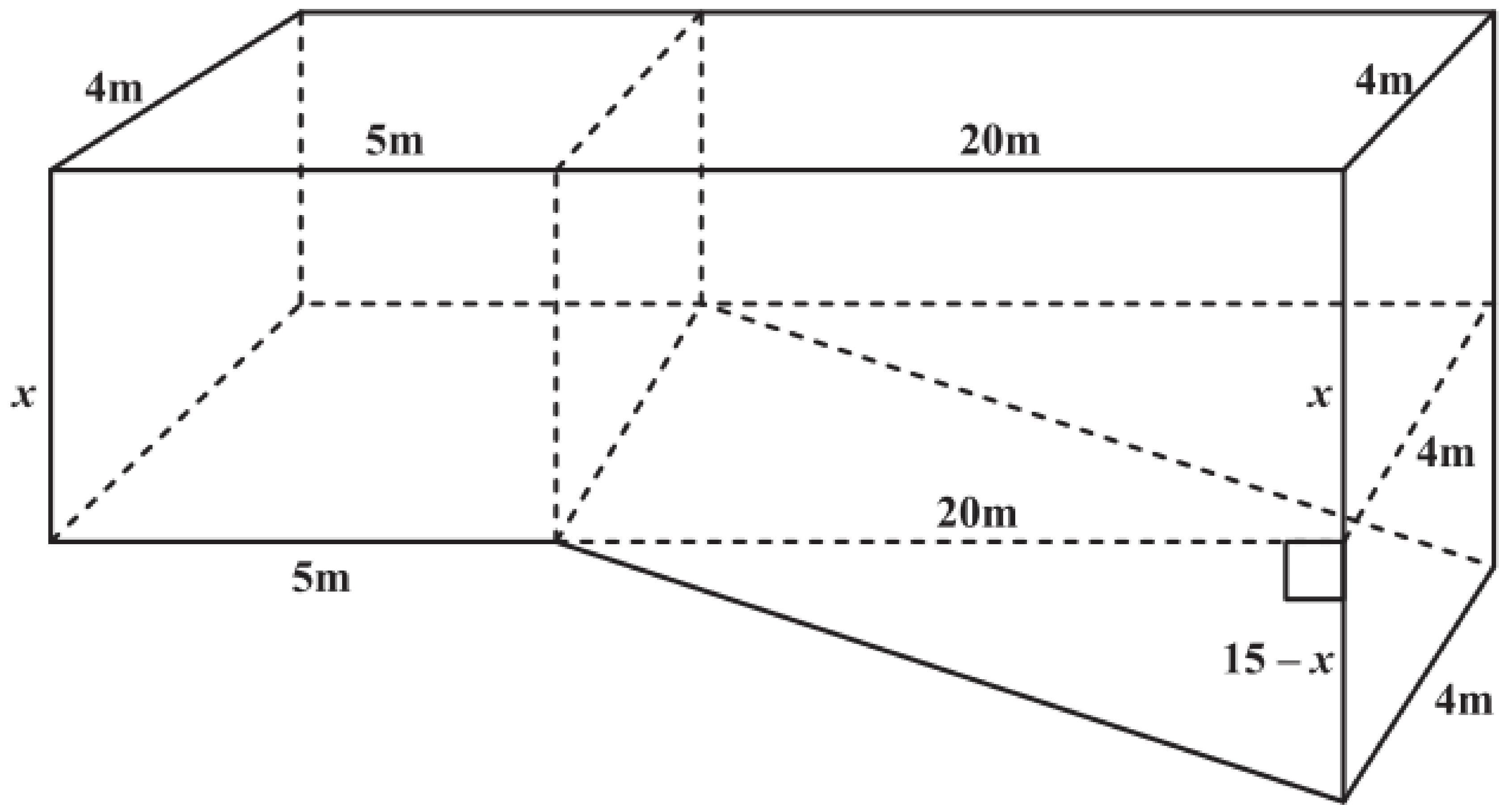
4)



a) $V = (5\times 4\times x) + (20\times 4\times x) + \frac{1}{2}(20)(15-x)(4)$

$= 20x + 80x + 40(15-x)$

$= 20x + 80x + 600 - 40x$

$= 600 + 60x \text{ m}^3$

b) $600 + 60x = 900$

$\therefore 60x = 300$

$\therefore x = 5\text{ m}$

The Mixed Exercise number 4 is on page **364**

Chapter 18 – Transformational Geometry

Translations (from pages 192 and 193)

Exercise 1:

1) Write down the image of point $A(-3;2)$ after A is translated:

a) According to the rule $A(x;y) \rightarrow A'(x-3;y)$

b) 3 units right

c) 3 units up

d) 3 units down

e) According to the rule $A(x;y) \rightarrow A'(x-2;y+1)$

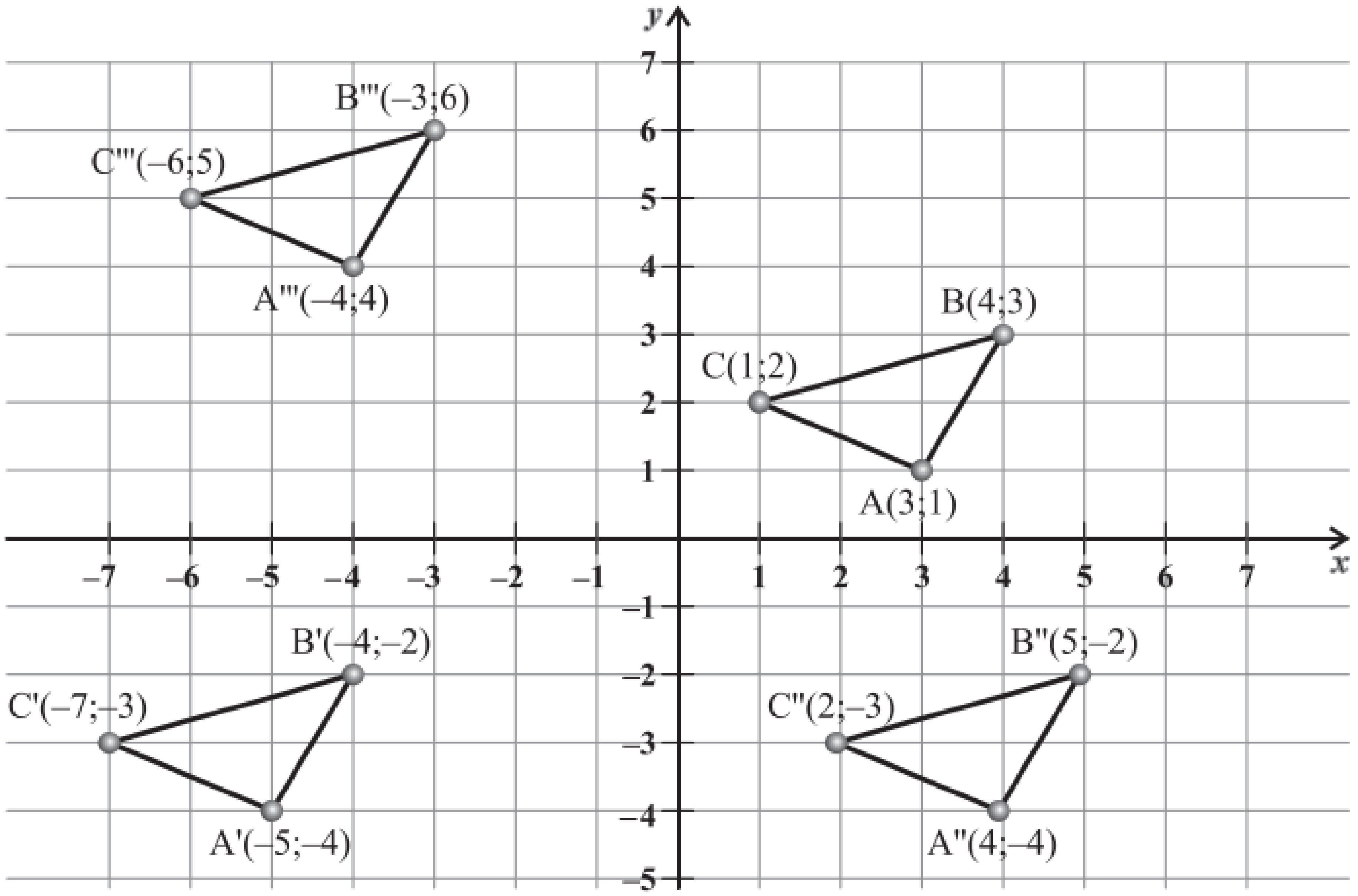
f) 5 units right and 3 units down

g) 6 units right and 10 units up

h) 7 units down and 4 units right

Solutions to Exercise 1 number 1 are on page 373

2) State the rule in the form of $P(x;y) \rightarrow P'(x+a;y+b)$, for the translation from:



a) ΔABC to ΔA'B'C'

b) ΔABC to ΔA''B''C''

c) ΔABC to ΔA'''B'''C'''

d) ΔA'B'C' to ΔA''B''C''

e) ΔA'B'C' to ΔA'''B'''C'''

f) Δ A'''B'''C''' to ΔABC

Solutions to Exercise 1 number 2 are on page 373

3) Plot the following points or figures given below on a Cartesian plane:

a) A(5;3)

b) A', the image of A after a translation of 3 units down and 4 unit left.

c) A'', the image of A after a translation of 2 units up and 1 units right.

d) ΔPQR with vertices P(4;–4), Q(2;–3) and R(5;–2).

e) ΔP'Q'R', the image of ΔPQR after a translation of 9 units left.

f) ΔP''Q'R', the image of ΔP'Q'R' after a translation of 1 unit right and 5 units up.

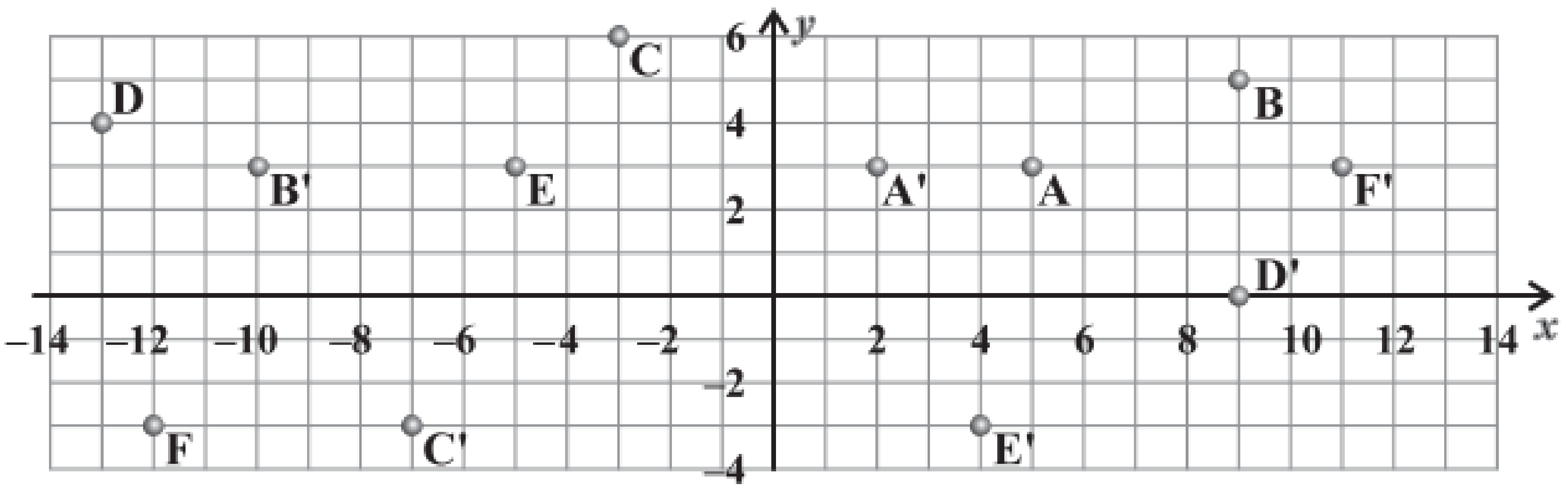
Solutions to Exercise 1 number 3 are on page 373

4) Using your diagram in question 3 above, determine the following ratios:

a) $\dfrac{\text{Perimeter } \Delta ABC}{\text{Perimeter } \Delta A'B'C'}$ **b)** $\dfrac{\text{Perimeter } \Delta A''B''C''}{\text{Perimeter } \Delta ABC}$ **c)** $\dfrac{\text{Perimeter } \Delta A''B''C''}{\text{Perimeter } \Delta A'B'C'}$

Solutions to Exercise 1 number 4 are on page 373

5) Determine the translation if points A, B, C, D, E and F are mapped onto their respective images. State a general rule in the form $P(x;y) \rightarrow P'(x+a;y+a)$



Solutions to Exercise 1 number 5 are on page 373

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Reflections (from pages 194 - 196)

Exercise 2:

1) Write down the rule in words for each transformation shown below:

a) $A(3;2) \rightarrow A'(-3;2)$

b) $B(-3;1) \rightarrow B'(-3;-1)$

c) $C(-5;-7) \rightarrow C'(5;-7)$

d) $D(-2;1) \rightarrow D'(1;-2)$

e) $E(6;-3) \rightarrow E'(6;3)$

f) $F(10;21) \rightarrow F'(21;10)$

Solutions to Exercise 2 number 1 are on page **373**

2) ΔABC has vertices A(5;2), B(6;4) and C(3;3):

a) Draw ΔABC on a Cartesian plane.

b) Draw ΔA'B'C', the image of ΔABC after a transformation with a rule of $P(x;y) \rightarrow P'(-x;y)$.

c) Draw ΔA"B"C", the image of ΔABC after a transformation with a rule of $P(x;y) \rightarrow P'(x;-y)$.

d) Draw ΔA'"B'"C'", the image of ΔABC after a transformation with a rule of $P(x;y) \rightarrow P'(y;x)$.

Solutions to Exercise 2 number 2 are on page **374**

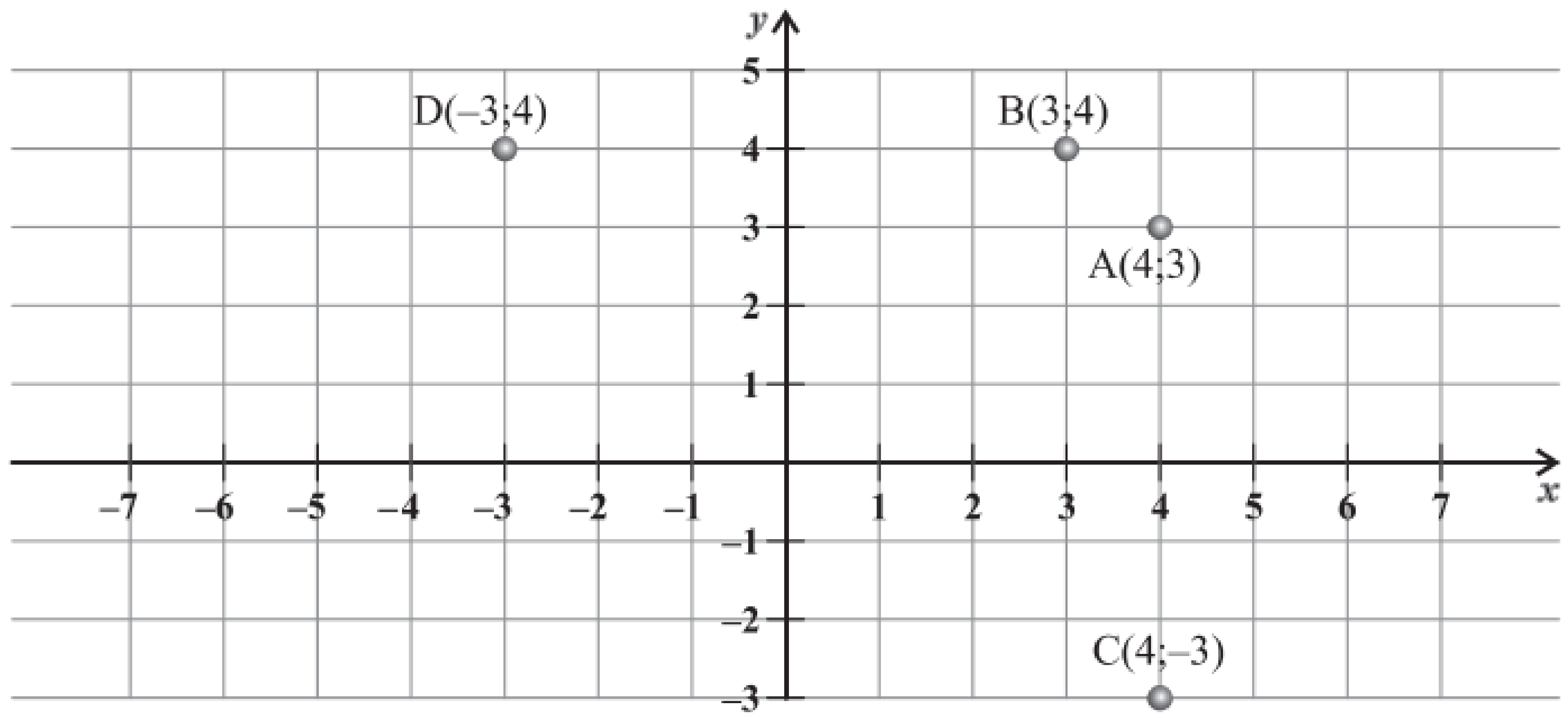
3) Use the figure below to state the type of reflections that has taken place from point:

a) A to B

b) A to C

c) B to D

d) C to D



Solutions to Exercise 2 number 3 are on page **374**

4) The point $A(5;3)$ transformed to obtain the image A'' by undergoing two consecutive transformations. The rule to obtain A'' is $P(x;y) \rightarrow P'(x+5;y-3) \rightarrow P''(y;x)$. Write down the coordinates of A''.

Solutions to Exercise 2 number 3 are on page **374**

Enlargements (from pages 197 - 199)

Exercise 3:

1) Line AB has vertices $A(-3;-2)$ and $B(6;-2)$.

a) Determine the coordinates of A' and B' the image of A and B after an enlargement by a scale factor of 5.

b) Write down the value of $\frac{A'B'}{AB}$.

Solutions to Exercise 3 number 1 are on page **374**

2) Figure ABCD has vertices A(–1;2), B(–3;1), C(–1;–2) and D(1;1).

a) Draw ABCD on a Cartesian plane.

b) On the same set of axes draw A'B'C'D', the image of ABCD after an enlargement by scale factor of 2.

c) Write down the value of $\frac{A'B'}{AB}$.

d) Write down the value of $\frac{\text{Perimeter ABCD}}{\text{Perimeter A'B'C'D'}}$.

e) Write down the value of $\frac{\text{Area A'B'C'D'}}{\text{Area ABCD}}$.

Solutions to Exercise 3 number 2 are on page **374**

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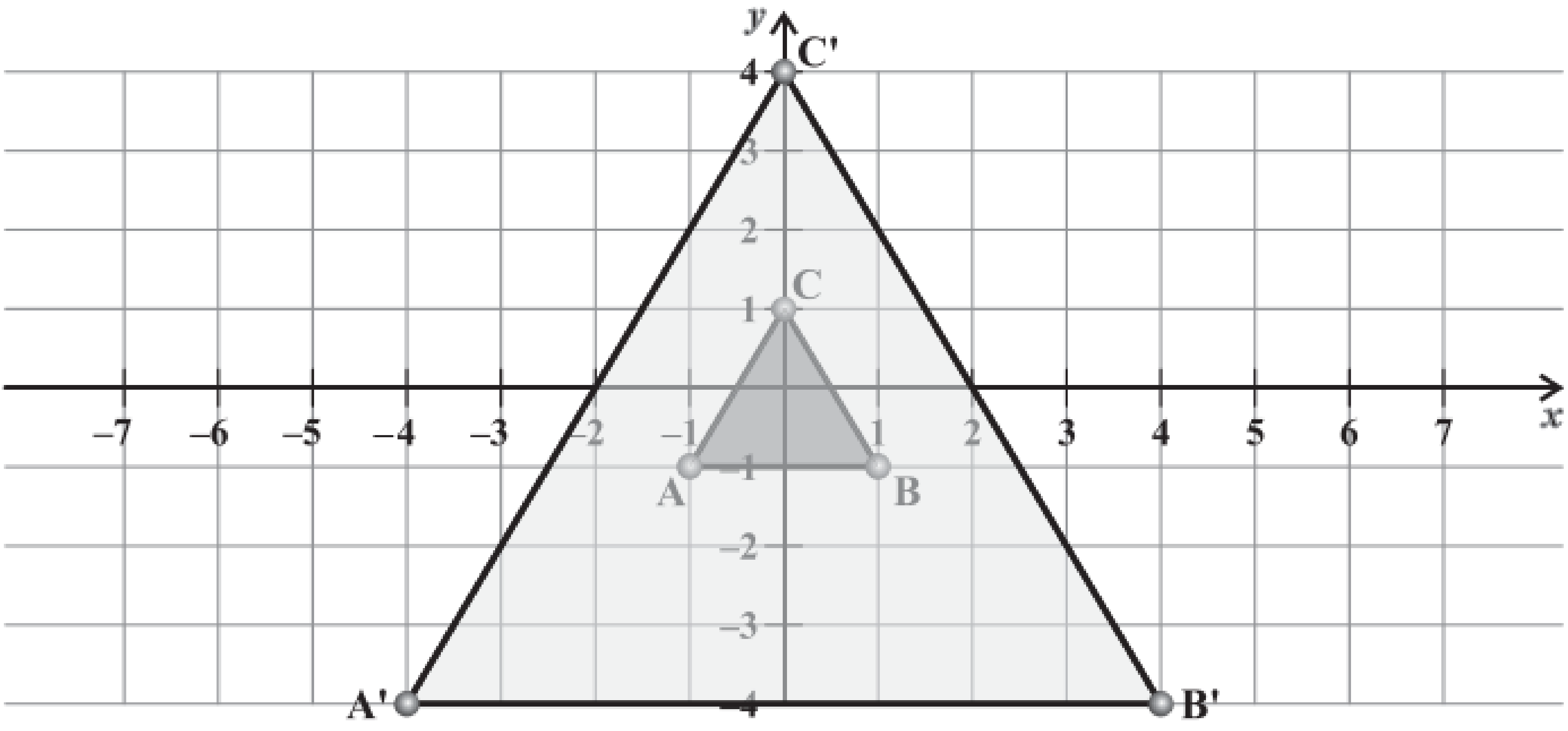
3) ΔABC and its image ΔA'B'C' are drawn below.



a) What type of transformation has taken place from ΔABC to its image ΔA'B'C'.

b) Write down the value of the ratio $\frac{AB}{A'B'}$.

c) Write down the value of the ratio $\frac{\text{Perimetre } \Delta A'B'C'}{\text{Perimetre } \Delta ABC}$.

d) Write down the value of the ratio $\frac{\text{Area } \Delta A'B'C'}{\text{Area } \Delta ABC}$.

e) If ΔA'B'C' is enlarged by a scale factor of k to obtain ΔABC, what is the value of k?

Solutions to Exercise 3 number 3 are on page **375**

<u>Mixed Exercise</u>:

1) Given points A(1;–2), B(2;–3), C(3;–2), D(3;1), E(5;1), F(4;3), G(3;4), H(2;3), I(1;1)

a) Plot the above points on a Cartesian plane. Join the points in alphabetical order and lastly join I to D.

b) The figure is then reflected about the line $x = 0$ to obtain the image A'B'C'D'E'F'G'H'. Draw A'B'C'D'E'F'G'H' on the same Cartesian plane.

c) The reflected image is then transformed according to the rule $P(x;y) \rightarrow P'(x-5;y+2)$ to obtain A"B"C"D"E"F"G"H"I". Sketch the image A"B"C"D"E"F"G"H"I".

Solutions to the Mixed Exercise number 1 are on page **375**

2) ABCD is a rhombus. Write down the scale factor of the enlargement that has taken place if:

a) $\frac{A'B'}{AB} = 3$

b) CD = 2C'D'

c) $\frac{AB}{A'B'} = 5$

d) $\frac{AB}{A'B'} = \frac{1}{5}$

e) Area of A'B'C'D' = 16(Area of ABCD)

f) $\frac{\text{Area of } A'B'C'D'}{\text{Area of ABCD}} = 2$

Solutions to the Mixed Exercise number 2 are on page **375**

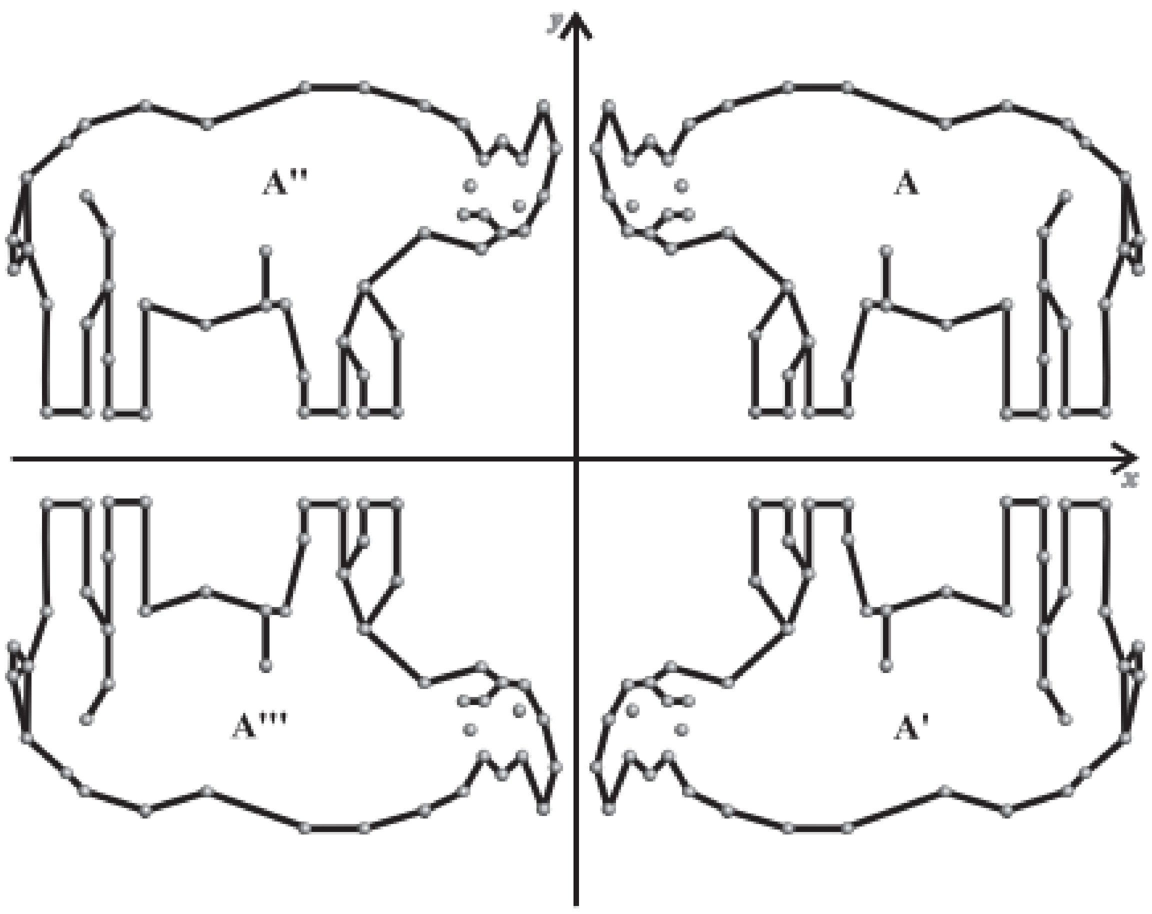
3) The diagram alongside shows rhino A drawn along with images obtained from various transformations.

a) Write down the rule used to transform A to A'.

b) Write down the rule used to transform A to A".

c) Write down two consecutive rules that could be used to transform A to A'".

Solutions to the Mixed Exercise number 3 are on page 375



4) The eye of rhino A has coordinates (2;7). Use your answers in question 3 above to write down the coordinates of the eye in rhino:

a) A'.

b) A".

c) A'".

Solutions to the Mixed Exercise number 4 are on page **375**

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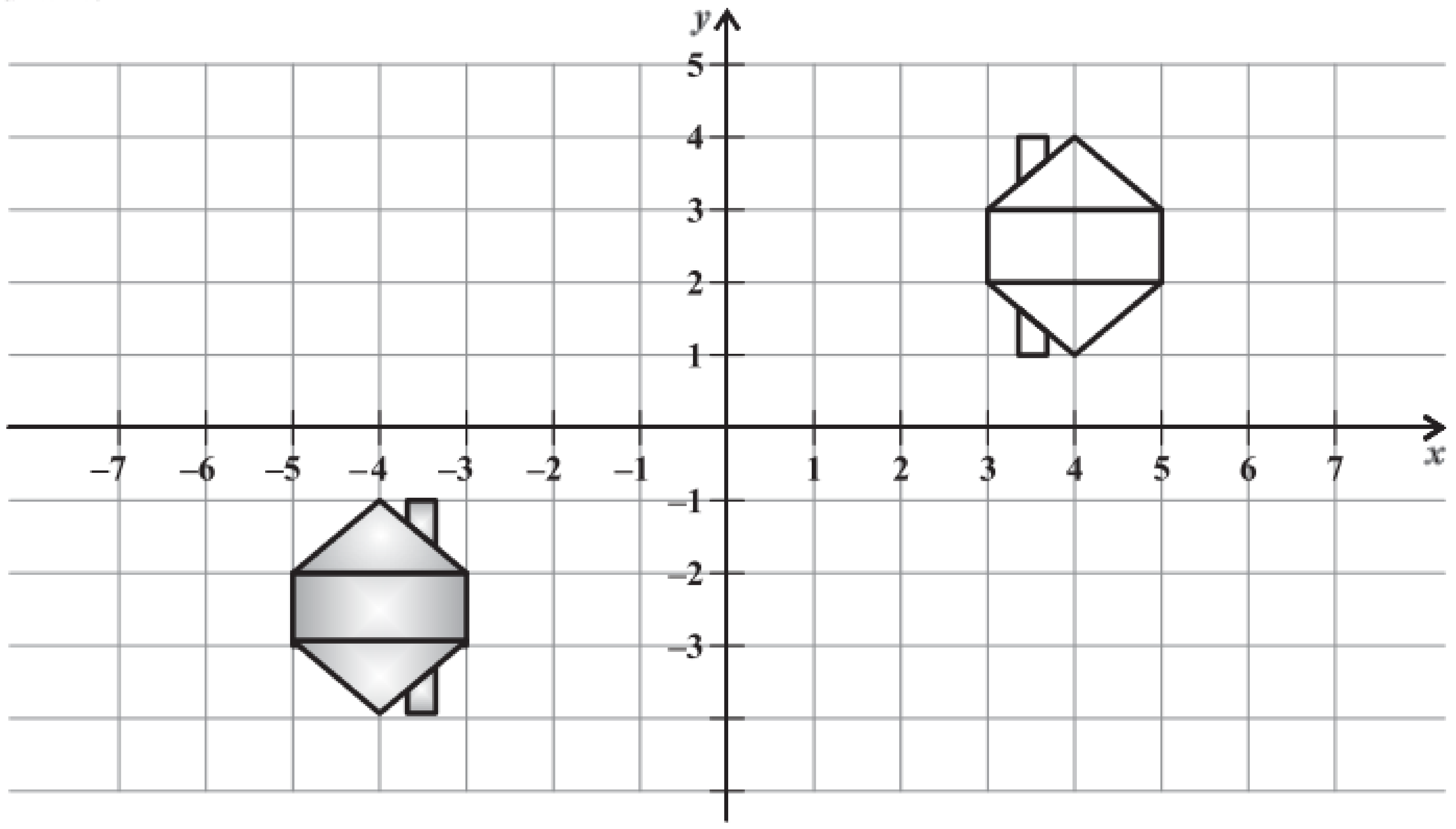
5) The unshaded figure in the 1st quadrant is transformed to the shaded figure shown in the 4th quadrant.

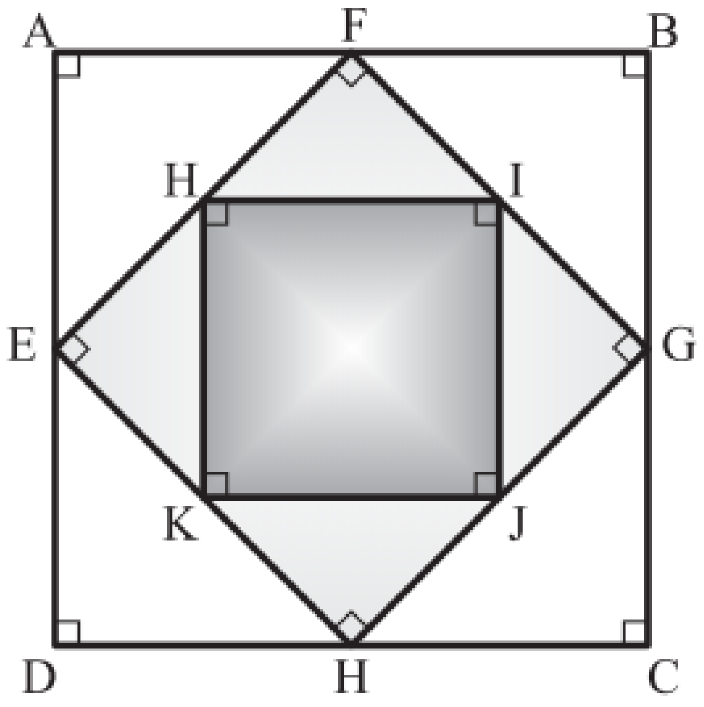


- Xoliso claims that the transformation is a reflection in the y-axis followed by a reflection in the x-axis.
- Cassidy claims that the transformation is a reflection in the x-axis followed by a reflection in the y-axis.
- Anika claims that the transformation is a translation 8 units left and 5 units down.

Who is correct? Explain your answer.

Solutions to the Mixed Exercise number 6 are on page 375

6) Three squares are drawn below. Square EFGH is constructed by joining the midpoints of ABCD. Square HIJK is formed by joining the midpoints of EFGH. AB is 20 units in length.



a) Determine the area of ABCD.
b) Determine the area of HIJK.
c) If HIJK is the image of ABCD after a reduction by a scale factor of k, determine the value of k.

Solutions to the Mixed Exercise number 6 are on page 376

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Chapter 18 – Transformational Geometry (Solutions)

Exercise 1 Solutions:

1)

a) $A'(-6;2) \to A'(-3-3;2)$

b) $A'(0;2) \to A'(-3+3;2)$

c) $A'(-3;5) \to A'(-3;2+3)$

d) $A'(-3;-1) \to A'(-3;2-3)$

e) $A'(-5;3) \to A'(-3-2;2+1)$

f) $A'(2;-1) \to A'(-3+5;2-3)$

g) $A'(3;12) \to A'(-3+6;2+10)$

h) $A'(1;-5) \to A'(-3+4;2-7)$

Exercise 1 number 1 is on page 369

2)

a) $P(x;y) \to P'(x-8;y-5)$

b) $P(x;y) \to P'(x+1;y-5)$

c) $P(x;y) \to P'(x-7;y+3)$

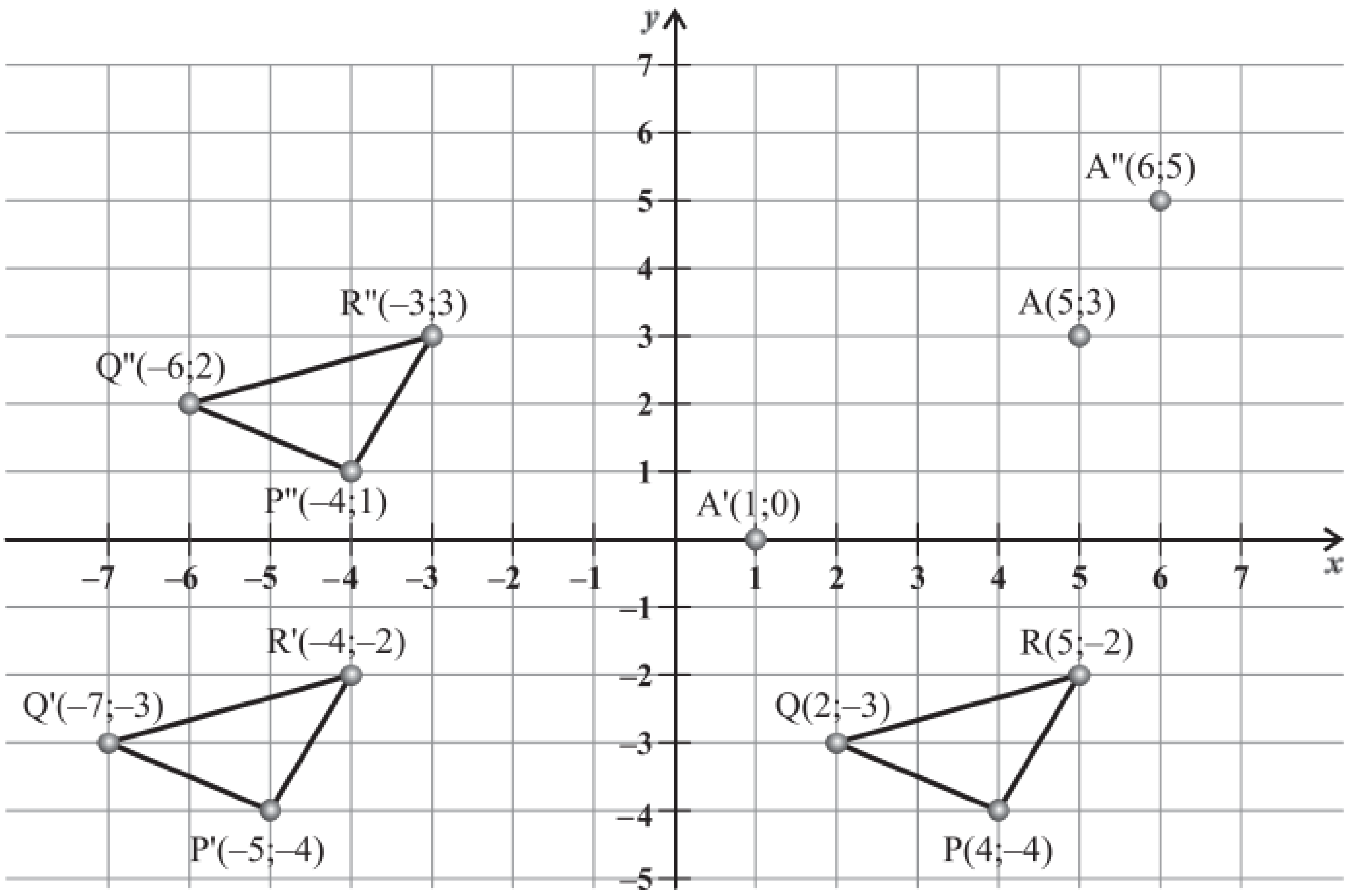
d) $P(x;y) \to P'(x+9;y)$

e) $P(x;y) \to P'(x+1;y+8)$

f) $P(x;y) \to P'(x+7;y-3)$

Exercise 1 number 2 is on page 369

3)



Exercise 1 number 3 is on page 369

4) Translating a shape produces a congruent figure. This means the lengths of the sides of the image are the same as the original.

a) $\dfrac{\text{Perimeter } \Delta ABC}{\text{Perimeter } \Delta A'B'C'} = 1$

b) $\dfrac{\text{Perimeter } \Delta A''B''C''}{\text{Perimeter } \Delta ABC} = 1$

c) $\dfrac{\text{Perimeter } \Delta A''B''C''}{\text{Perimeter } \Delta A'B'C'} = 1$

Exercise 1 number 4 is on page 369

5)

a) $A(x;y) \to A'(x-3;y)$

b) $B(x;y) \to B'(x-19;y-2)$

c) $C(x;y) \to C'(x-4;y-9)$

d) $D(x;y) \to D'(x+22;y-4)$

e) $E(x;y) \to E'(x+9;y-6)$

f) $F(x;y) \to F'(x+23;y+6)$

Exercise 1 number 4 is on page 369

Exercise 2 Solutions:

1)

a) Reflection about the y-axis

b) Reflection about the x-axis

c) Reflection about the y-axis

d) Reflection about the line $y = x$

e) Reflection about the x-axis

f) Reflection about the line $y = x$

Exercise 2 number 1 is on page 370

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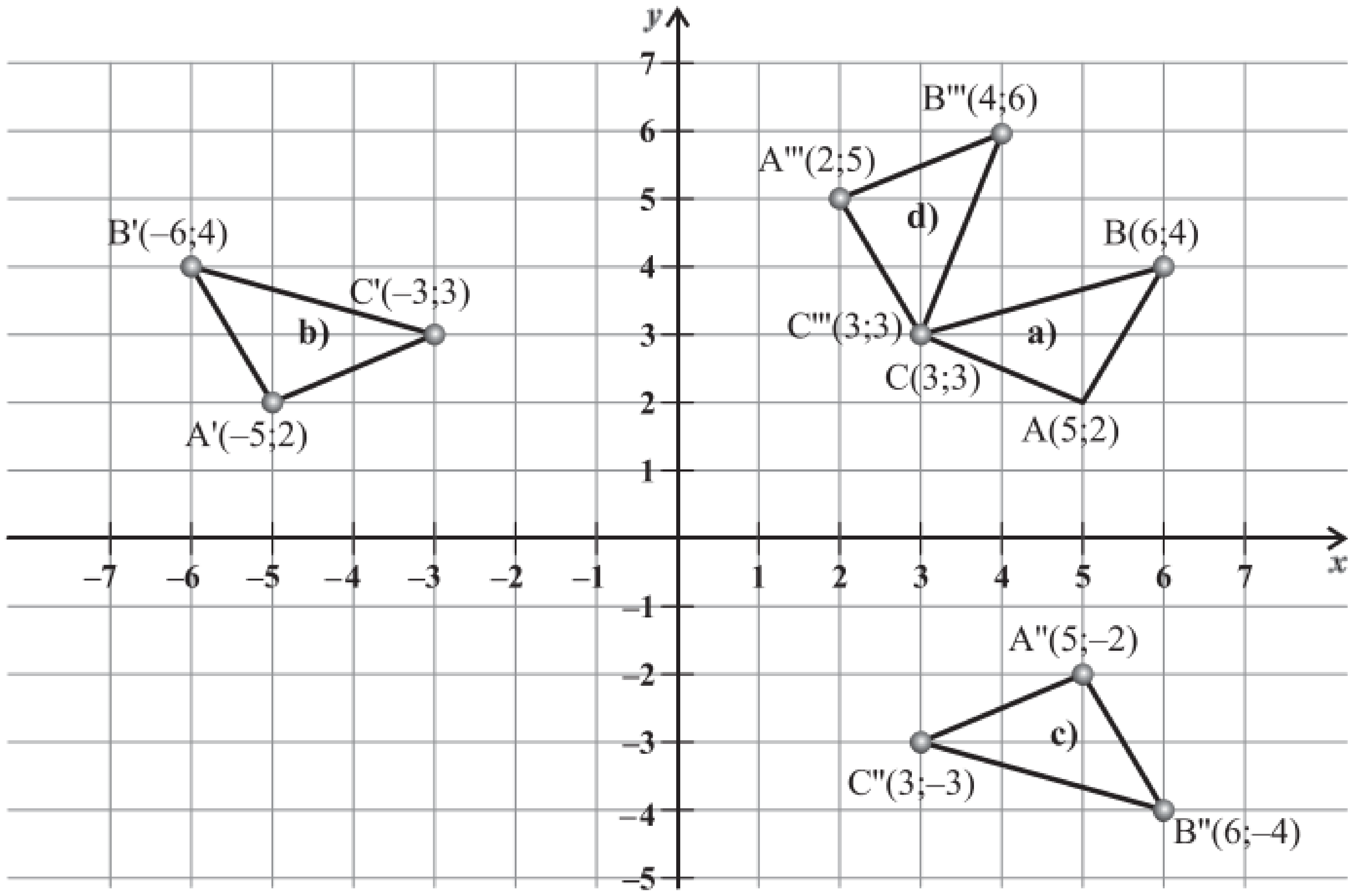
2)



Exercise 2 number 2 is on page 370

3)

a) Reflection about the line $y = x$

b) Reflection about the x-axis

c) Reflection about the y-axis

d) Reflection about the line $y = x$

Exercise 2 number 3 is on page 370

4) $A(5;3)$

$A'(10;0) \rightarrow A'(5+5;3-3)$

$A''(0;10) \rightarrow$ reflection about the line $y = x$, swap x and y-values

Exercise 2 number 4 is on page 370

Exercise 3 Solutions:

1)

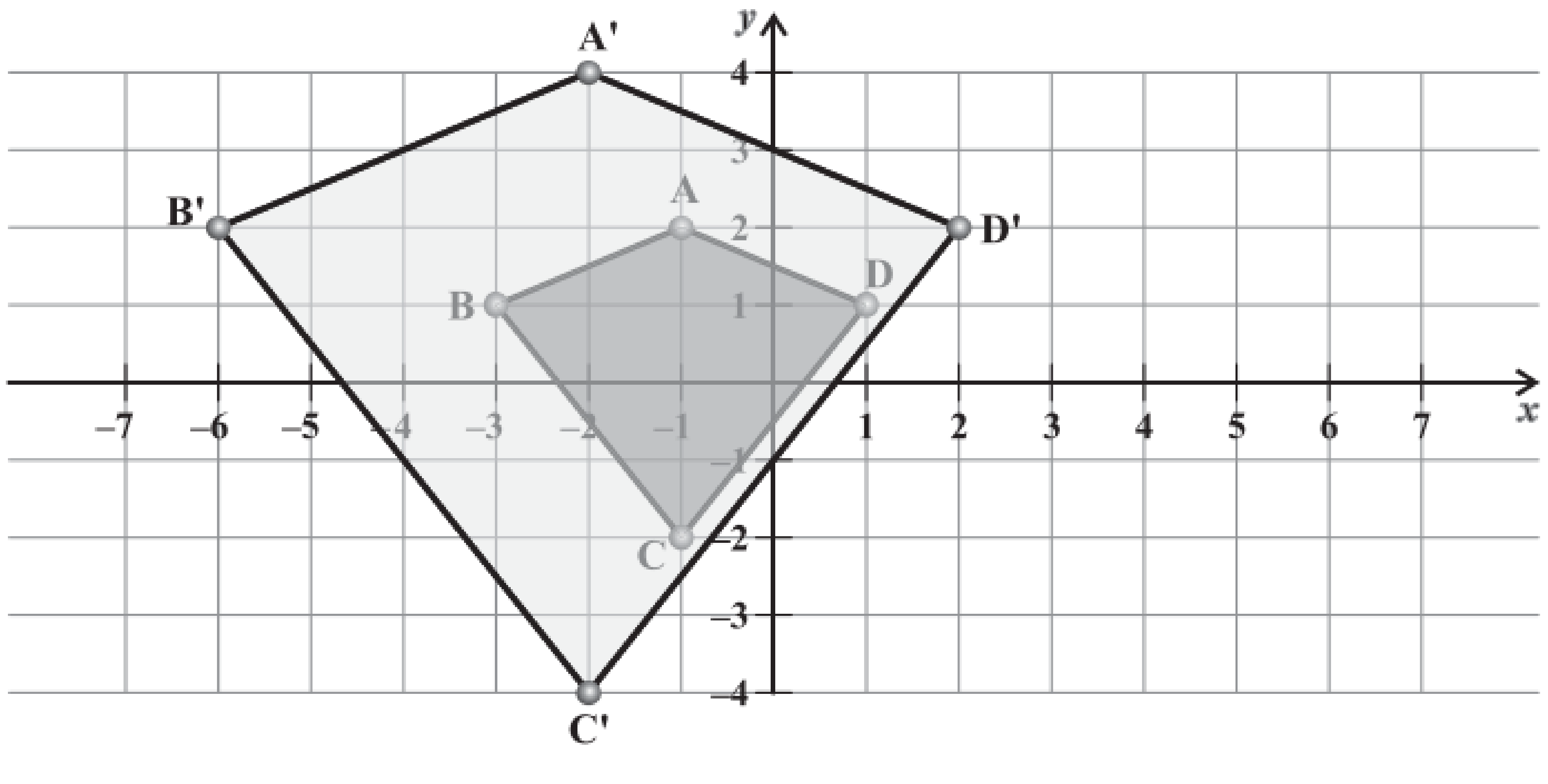
a) $A'(-15;-10)$

$B'(30;-10)$

b) $\dfrac{A'B'}{AB} = 5$

Exercise 3 number 1 is on page 370

2)
a)
b)



c) $\dfrac{A'B'}{AB} = 2$

d) $\dfrac{\text{Perimeter ABCD}}{\text{Perimeter A'B'C'D'}} = \dfrac{1}{2}$

e) $\dfrac{\text{Area A'B'C'D'}}{\text{Area ABCD}} = 2^2 = 4$

Exercise 3 number 2 is on page 370

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3)

a) An enlargement by a scale factor of 4

b) $\frac{AB}{A'B'} = \frac{1}{4}$

c) $\frac{\text{Perimetre } \Delta A'B'C'}{\text{Perimetre } \Delta ABC} = 4$

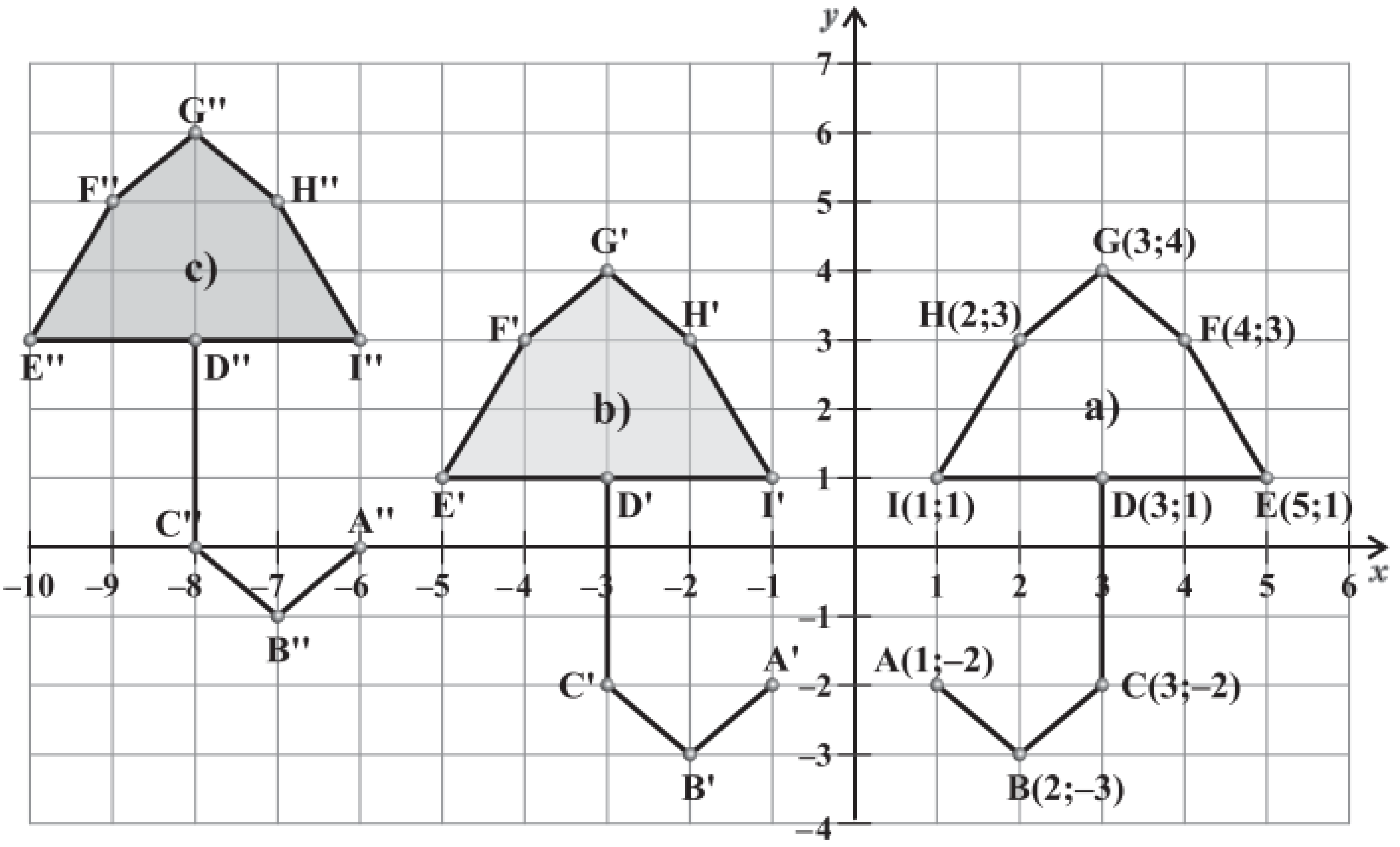
d) $\frac{\text{Area } \Delta A'B'C'}{\text{Area } \Delta ABC} = 4^2 = 16$

e) $k = \frac{1}{4}$

Exercise 3 number 3 is on page **371**

Mixed Exercise Solutions:

1)



The Mixed Exercise number 1 is on page **371**

2)

a) Enlargement by a scale factor of 3

b) Enlargement by a scale factor of $\frac{1}{2}$

c) Enlargement by a scale factor of $\frac{1}{5}$

d) Enlargement by a scale factor of 5

e) Enlargement by a scale factor of 4

f) Enlargement by a scale factor of $\sqrt{2}$

The Mixed Exercise number 1 is on page **371**

3)

a) Reflection about the *x*-axis

b) Reflection about the *y*-axis

c) $P(x;y) \to P'(x;-y) \to P''(-x;y)$

Alternatively, $P(x;y) \to P'(-x;y) \to P''(x;-y)$ is also correct

The Mixed Exercise number 3 is on page **371**

4)

a) $A'(2;-7)$

b) $A''(-2;7)$

c) $A'''(-2;-7)$

The Mixed Exercise number 4 is on page **371**

5) Xoliso and Cassidy are correct. A reflection in the *y*-axis followed by a reflection in the *x*-axis produces the same results as a reflection in the *y*-axis followed by a reflection in the *x*-axis.
Anika's answer would place the shape in the same position. However, if the shape was only translated, the rectangles extending from the triangles would still be on the right-hand side of the transformed shape.

The Mixed Exercise number 5 is on page **372**

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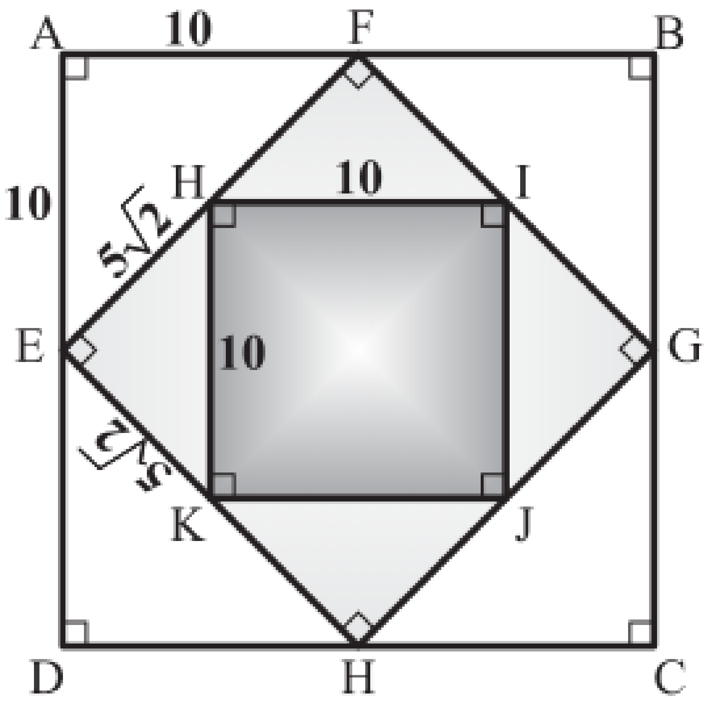
6)



a) Area of ABCD $= 20 \times 20 \rightarrow$ length $\times$ breadth

$= 400\,\text{units}^2$

b) $EF^2 = AE^2 + AF^2 \rightarrow$ Pythag

$= 10^2 + 10^2$

$= 200$

$\therefore EF = 10\sqrt{2}$

$\therefore EH = EK = 5\sqrt{2}$ units

$HK^2 = \left(5\sqrt{2}\right)^2 + \left(5\sqrt{2}\right)^2$

$= 100$

$\therefore HK = 10\,\text{units}^2$

$\therefore$ Area of HIJK $= 10 \times 10 \rightarrow$ length $\times$ breadth

$= 100\,\text{units}^2$

c) Reduction scale factor $= \sqrt{4} \rightarrow$ area of ABCD is 4 times larger than the area of HIJK

$\therefore k = 2$

The Mixed Exercise number 6 is on page **372**

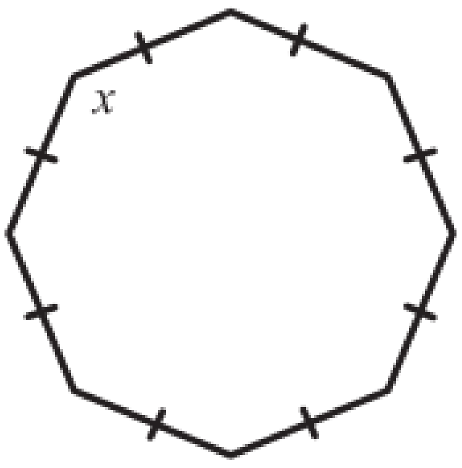
Chapter 19 – Geometry of 3D Shapes

Geometry of 3D Objects (from pages 202 - 206)

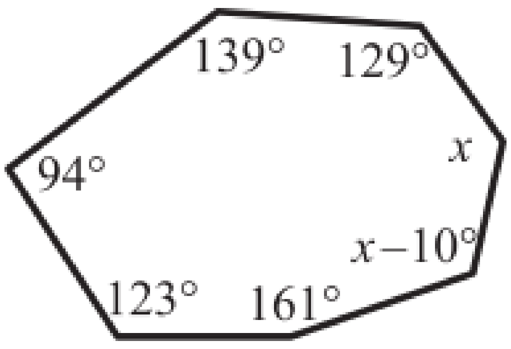
The Mixed Exercise

1) Determine the value of the x and/or y in each of the diagrams shown below.

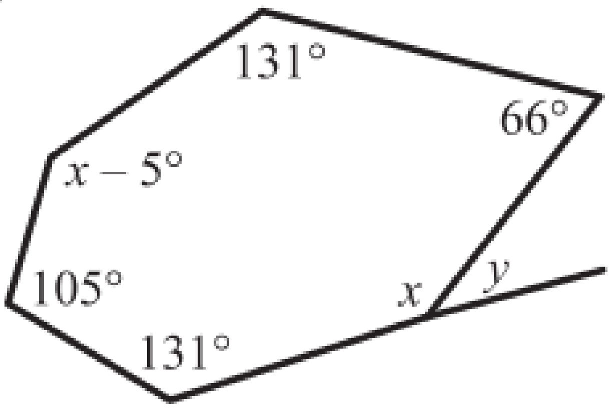
a)



b)



c)



Solutions to the Mixed Exercise number 1 are on page **380**

2) The number of faces, vertices and edges of shapes are given below. Use Euler's Law to determine if the shapes are polyhedrons:

a) Faces = 10
Vertices = 5
Edges =13

b) Faces = 5
Vertices = 8
Edges = 10

c) Faces = 20
Vertices = 8
Edges = 26

Solutions to the Mixed Exercise number 2 are on page **380**

3) A polyhedron has 9 faces and 4 vertices. How many edges does the polyhedron have?

Solutions to the Mixed Exercise number 3 are on page **380**

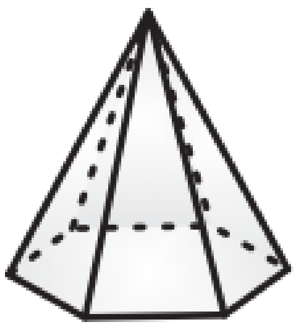
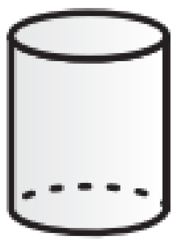
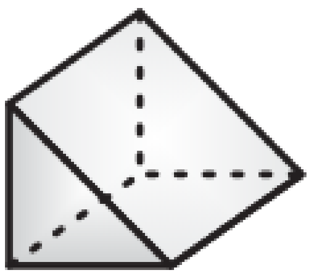
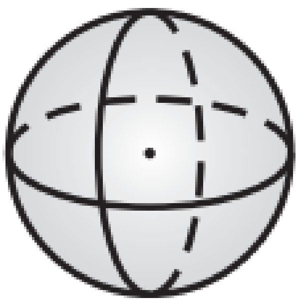
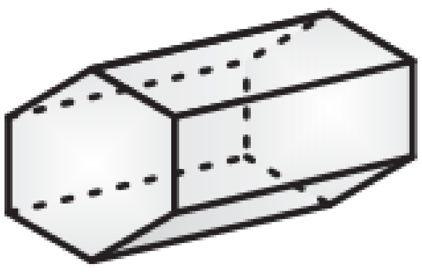
4) Answer the questions below:

a) Derive a formula to calculate the number of edges of a polyhedron.

b) James states that it is impossible for the number of vertices, faces and edges to all be odd. Is he correct? Use your answer above to explain your answer.

Solutions to the Mixed Exercise number 4 are on page **380**

5) Match the correct letters to the description in the table below:

	Type of Solid	Correct Letter	Shape
a)	**Sphere**		**A** 
b)	**Triangular prism**		**B** 
c)	**Pyramid with a hexagonal base**		**C** 
d)	**Hexagonal prism**		**D** 
e)	**Cylinder**		**E** 

Solutions to the Mixed Exercise number 5 are on page **380**

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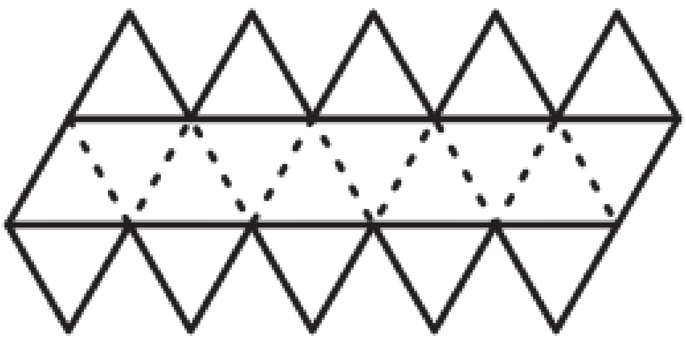
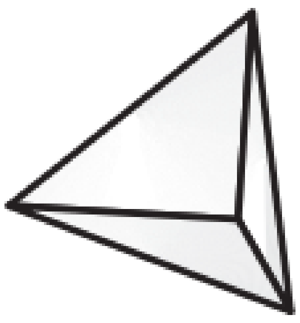
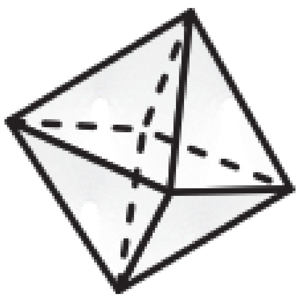
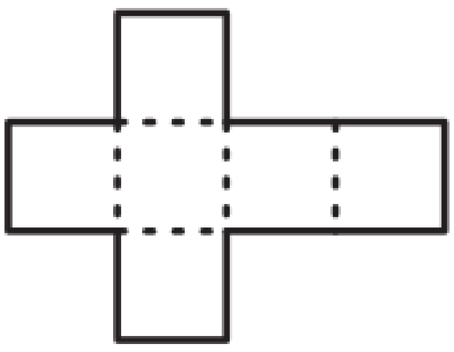
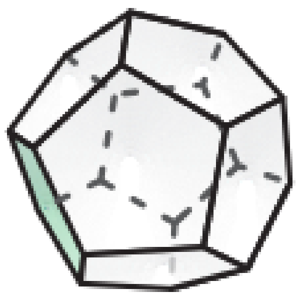
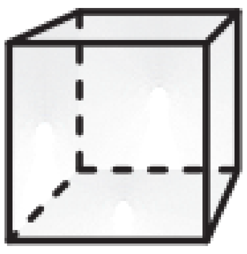
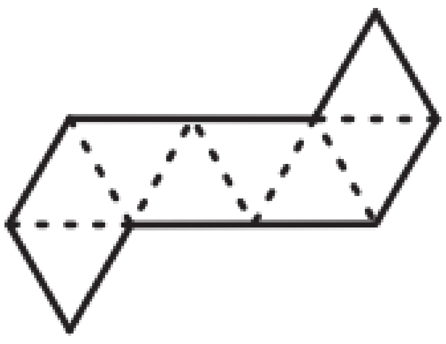
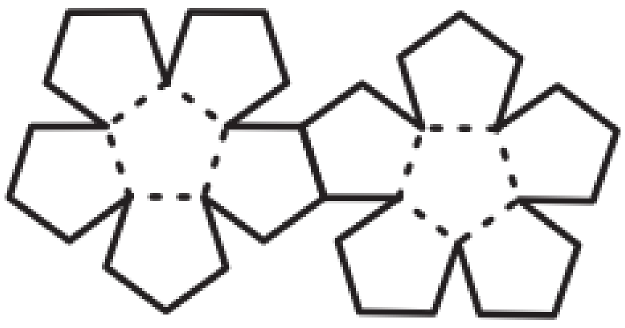
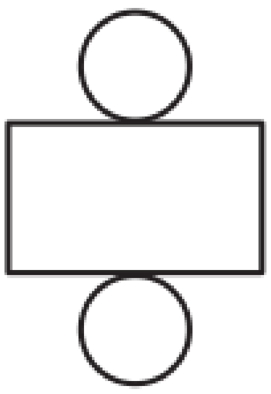
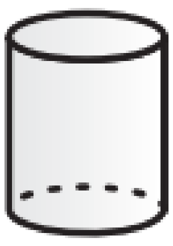
6) Fill out the table below using the shapes and nets shown under the table.

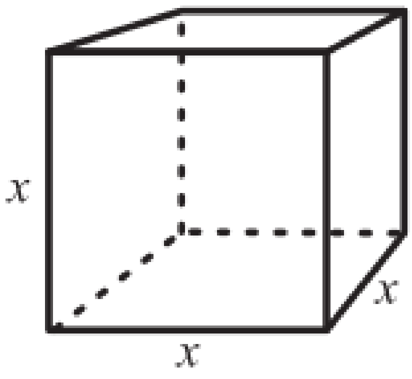
	Type of Solid	Letter of Shape	Letter of Net
a)	Tetrahedron		
b)	Hexahedron		
c)	Octahedron		
d)	Dodecahedron		
e)	Icosahedron		
f)	Cylinder		

A	B	C
		
D	**E**	**F**
		
G	**H**	**I**
		
J	**K**	**L**
		

Solutions to the Mixed Exercise number 6 are on page **381**

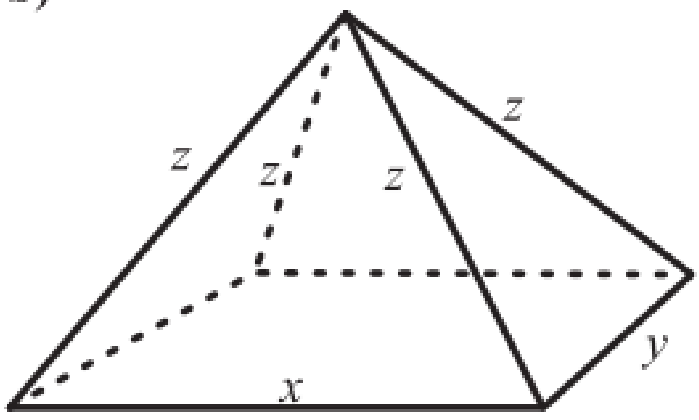
7) Draw a net for each of the shapes below.

a)



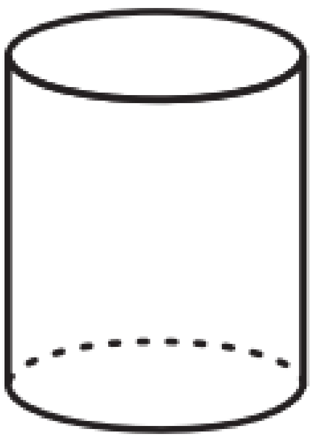
Square prism

b)



Rectangular based pyramid

c)



Cylinder with height $2r$ and radius r

Solutions to the Mixed Exercise number 7 are on page **381**

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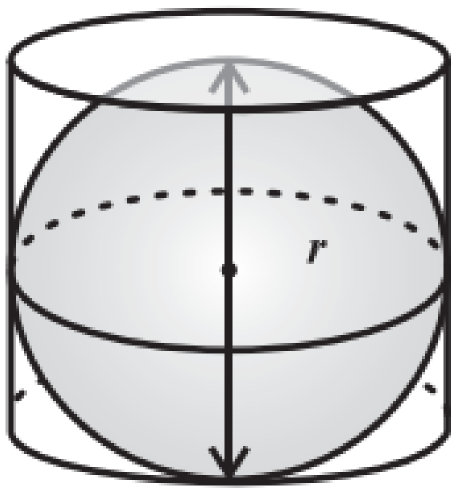
8) The diagram below shows a tennis ball which fits exactly into its container. The tennis ball has a radius of *r*.



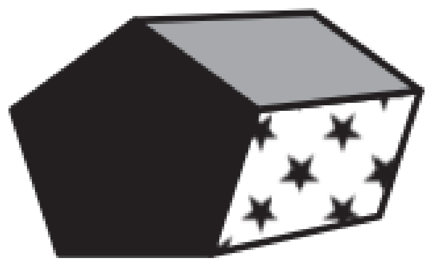
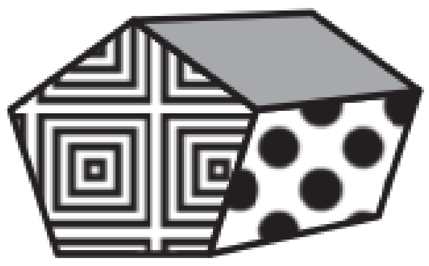
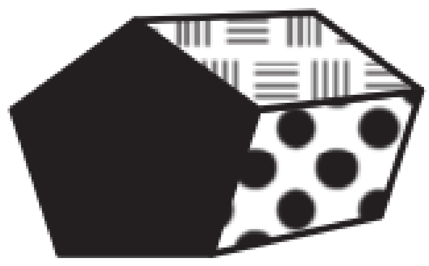
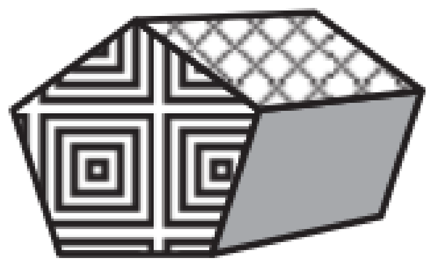
a) What is the height of the cylinder?

b) Natalia states that due to the shape of the tennis ball it has a larger volume than the cylinder. Aiden argues that the cylinder must have a larger volume, who is correct? Give a reason for your answer.

Solutions to the Mixed Exercise number 7 are on page 381

9) The net of a pentagonal prism is shown below:

Which of the pentagonal prisms shown below could be constructed from the net?

A	B	C	D
			

Solutions to the Mixed Exercise number 7 are on page 381

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Chapter 19 – Geometry of 3D Shapes (Solutions)

The Mixed Exercise Solutions:

1)

a) $x = \frac{180^\circ}{8}(8-2)$

$= 135^\circ$

b) $x + x - 10^\circ + 161^\circ + 123^\circ + 94^\circ + 139^\circ + 129^\circ = 180^\circ(7-2)$

$\therefore 2x + 636^\circ = 900^\circ$

$\therefore 2x = 264$

$\therefore x = 132^\circ$

c) $x + 131^\circ + 105^\circ + x - 5^\circ + 131^\circ + 66^\circ = 180^\circ(6-2)$

$\therefore 2x + 428^\circ = 720$

$\therefore 2x = 292^\circ$

$\therefore x = 146^\circ$

$y = 180^\circ - 146^\circ$

$= 34^\circ$

The Mixed Exercise number 1 is on page **377**

2) For any polyhedron $F + V - E = 2$

a) 10 + 5 – 13
=2
∴ it is a polyhedron

b) 5 + 8 – 10
= 3
∴ it is not a polyhedron

c) 20 + 8 – 26
= 2
∴ it is a polyhedron

The Mixed Exercise number 2 is on page **377**

3) $F + V - E = 2$

$\therefore 9 + 4 - E = 2$

$\therefore 13 - E = 2$

$\therefore -E = -11$

$\therefore E = 11$ edges

The Mixed Exercise number 3 is on page **377**

4)

a) $F + V - E = 2$

$\therefore F + V = E + 2$

$\therefore E = F + V - 2$

b) Two odd numbers added together are even. 2 subtracted from an even number is an even number.
$\therefore F + V - 2$ will always be even if F and V are odd. Therefore, James is correct.

The Mixed Exercise number 4 is on page **377**

5)

	Type of Solid	Correct Letter
a)	**Sphere**	**D**
b)	**Triangular prism**	**C**
c)	**Pyramid with a hexagonal base**	**A**
d)	**Hexagonal prism**	**E**
e)	**Cylinder**	**B**

The Mixed Exercise number 5 is on page **377**

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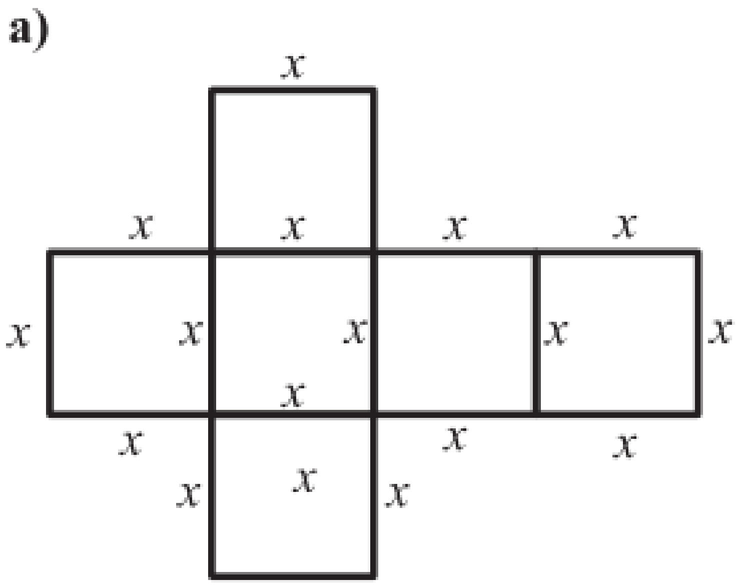
6)

	Type of Solid	Letter of Shape	Letter of Net
a)	Tetrahedron	B	F
b)	Hexahedron	H	E
c)	Octahedron	D	I
d)	Dodecahedron	G	J
e)	Icosahedron	C	A
f)	Cylinder	L	K

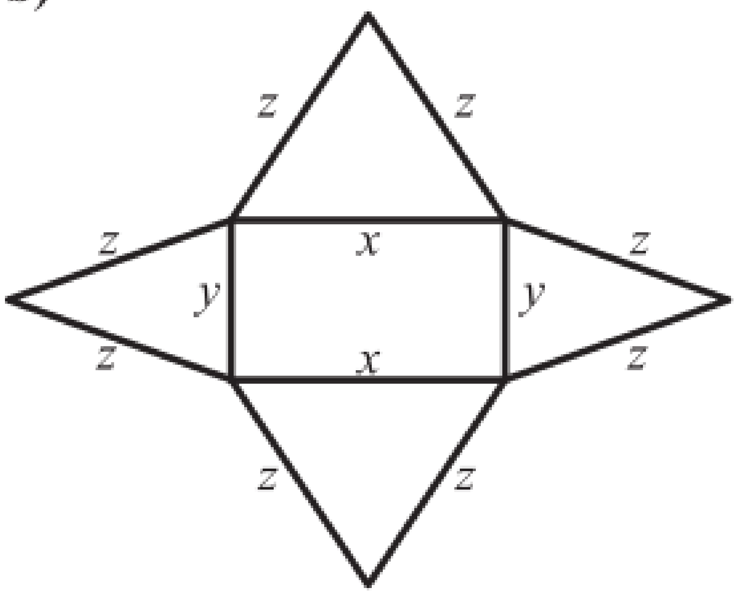
The Mixed Exercise number 6 is on page **378**

7) Draw a net for each of the shapes below:

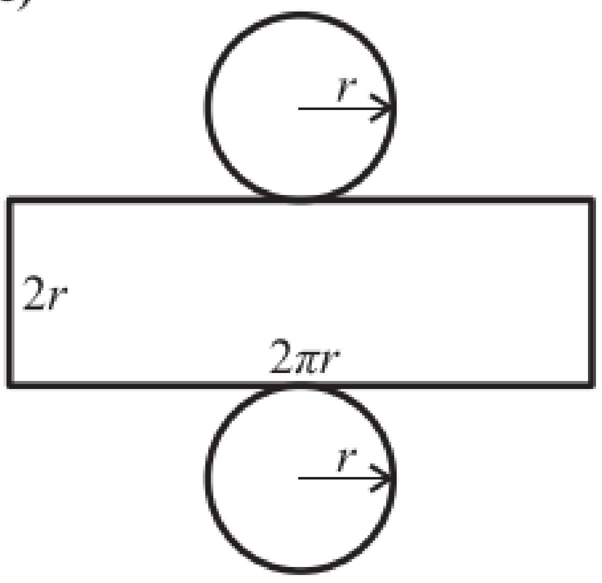
a)



b)



c)

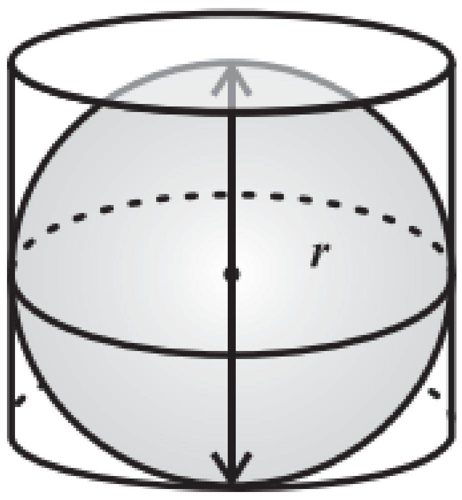


The Mixed Exercise number 7 is on page **378**

8)

a) $2r$

b) Aiden is correct. Volume is a measure of how much a container or shape can hold. For the sphere to fit inside the cylinder, the cylinder must have a larger volume.



The Mixed Exercise number 8 is on page **379**

9) B,C or D (A is not possible).

Solutions to the Mixed Exercise number 7 are on page **379**

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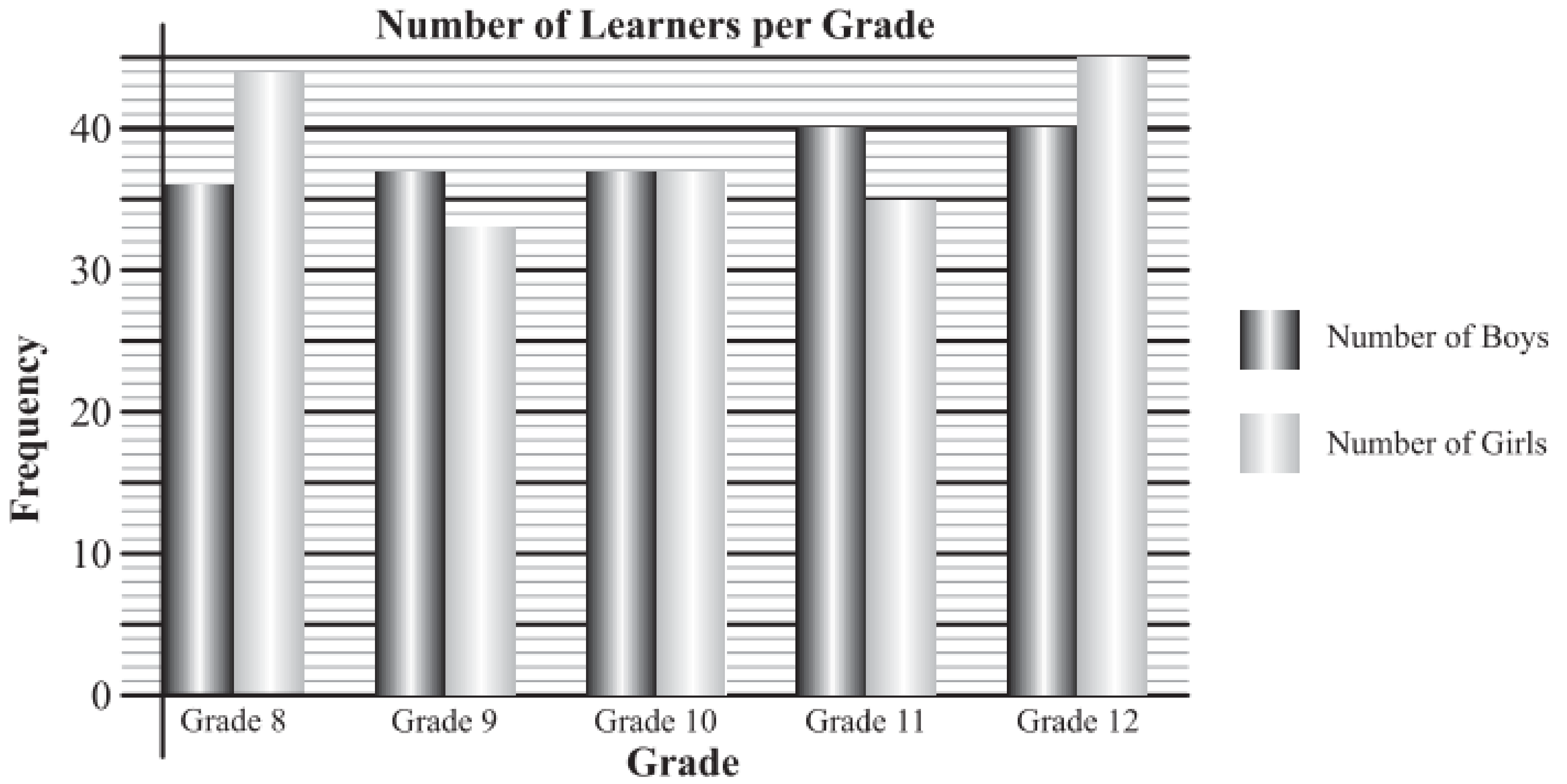
Chapter 20 – Data Handling

Grade 8 Revision (from pages 208 - 213)

Exercise 1:

1) Examine the compound bar graph below and answer the question which follow.



a) How many learners are there in Grade 9?
b) How many girls are there in Grade 12?
c) In which Grade are there an equal number of boys and girls?
d) How many more boys than girls are there in Grade 11?
e) How many learners are there in the school?

Solutions to Exercise 1 number 1 are on page **388**

2) The data in the tables below show the heights, in centimetres, of boys and girls in a Grade 9 class:

Girls' heights:

145	148	154	156	159	161	162	163
165	165	167	172	172	173	160	

Boys heights':

159	177	174	175	167	166	185	188
183	167	178	166	184	175	187	179

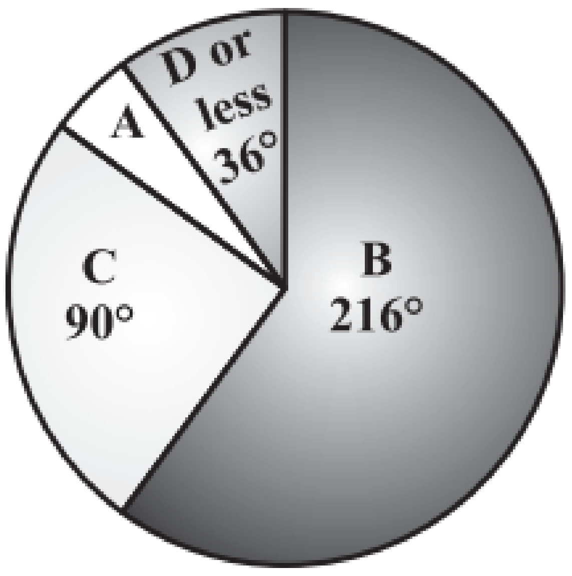
a) Draw a back to back stem and leaf plot for the data in the tables above.
b) Complete the frequency table below:

Interval	Boys	Girls
140 – 149		
150 – 159		
160 – 169		
170 – 179		
180 – 189		

c) How tall is the tallest person in the class?
d) If Lebo is 160cm tall, how many girls are shorter than Lebo?
e) How many boys are taller than Lebo?

Solutions to Exercise 1 number 2 are on page **388**

3) The pie chart shown below shows the results for a Grade 9 Mathematics cycle test.



a) What degree in the pie chart do learners who obtained an A represent?
b) If 200 learners wrote the test how many obtained an A?
c) What percentage of learners obtained a B?

Solutions to Exercise 1 number 1 are on page **388**

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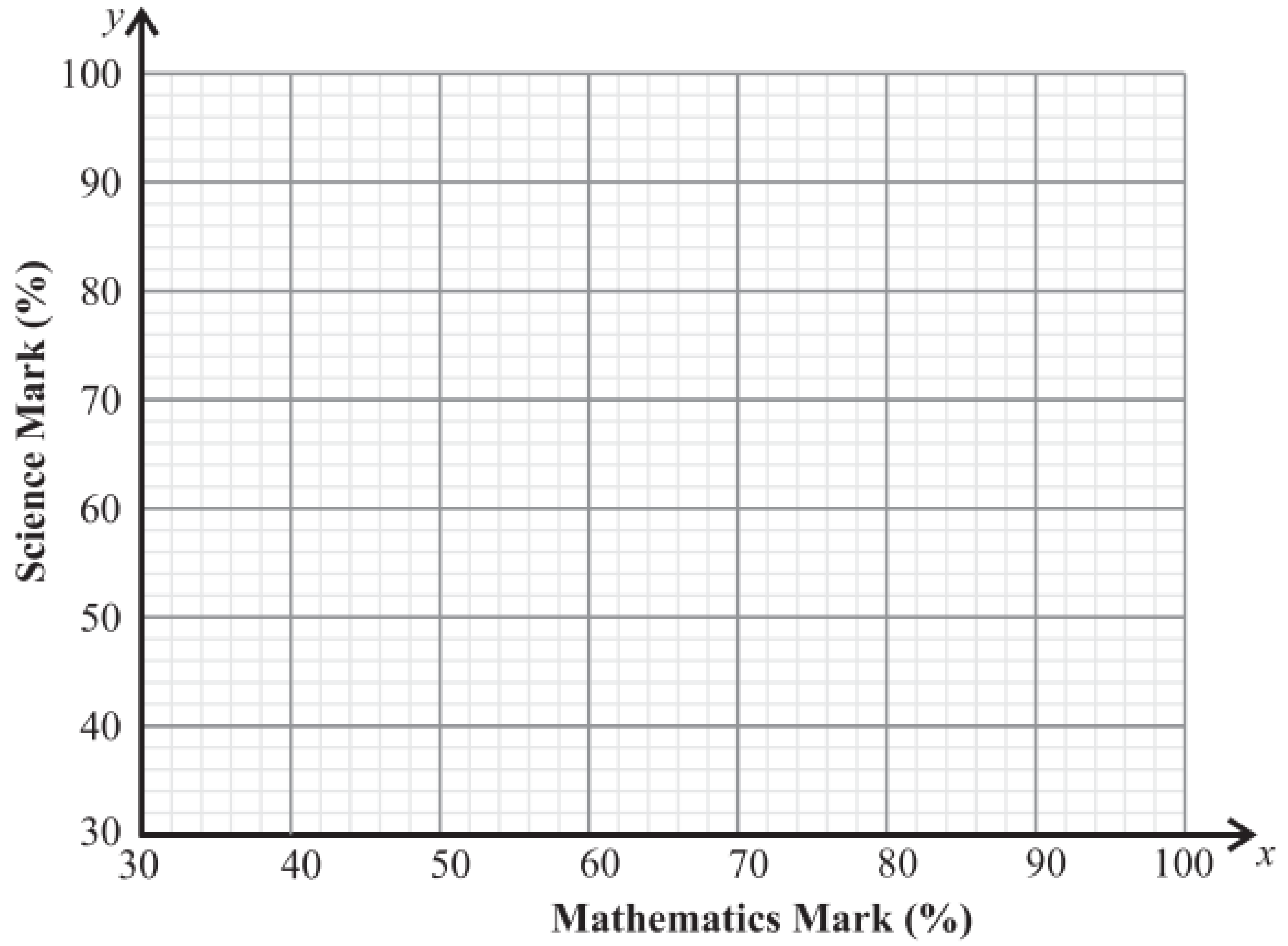
Scatter Plots (from pages 214 - 216)

Exercise 2:

1) The table below shows the results of a Grade 9 class in Mathematics and Physical Science.

Maths % (x)	40	46	52	58	60	64	66	70	72	76	78	80	76	84	88	98
Science % (y)	36	44	50	56	60	62	64	68	72	70	74	78	80	82	86	96

a) Draw a scatter plot on the axis below:



b) Draw a line of best fit on your scatter plot.

c) Describe the relationship between Mathematics and Physical Science marks.

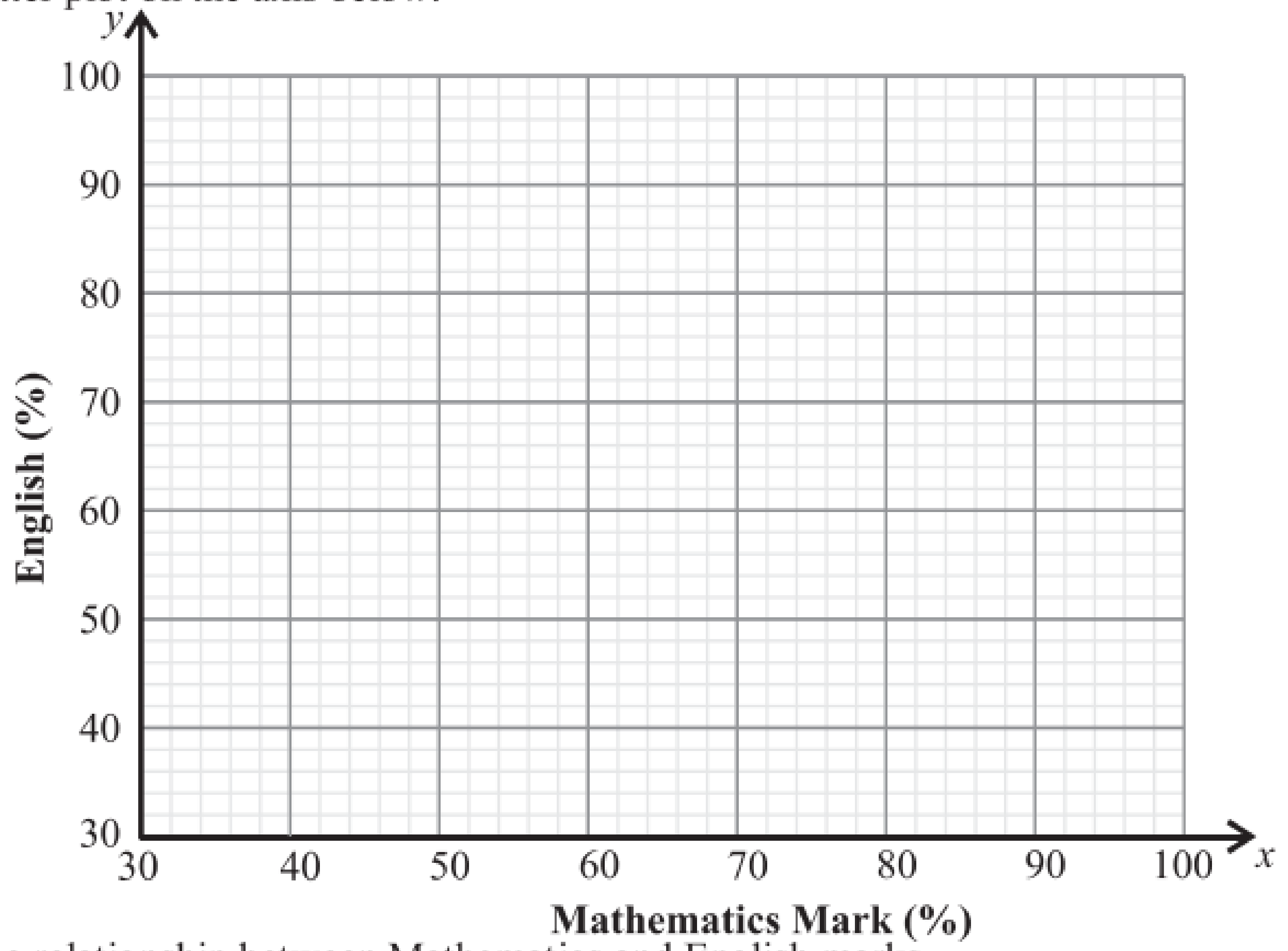
d) Predict what mark a learner achieved in Science if he received a mark of 68% in Maths?

Solutions to Exercise 2 number 1 are on page **388**

2) The table below shows the results of the same Grade 9 class in Mathematics and English.

Maths % (x)	40	46	52	58	60	64	66	70	72	76	78	80	76	84	88	98
English % (y)	66	72	80	50	38	75	58	76	60	94	84	40	50	66	94	90

a) Draw a scatter plot on the axis below:



b) Describe the relationship between Mathematics and English marks.

c) Would a line of best fit be useful on the above scatter plot? Explain your answer.

d) Is it fair to say that a learner who does well in Mathematics would also do well in English? Explain your answer.

Solutions to Exercise 2 number 2 are on page **389**

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3) Holly notices that a toilet in her house is leaking. She decides to set up an experiment to determine the amount of water that is wasted by a leaking toilet. She does so by collecting the leaking water in a bucket and measuring the volume of water in the bucket every half an hour. She does this for 3 hours. Her results are tabulated below:

Time in hours (x)	0	0,5	1	1,5	2	2,5	3	3,5
Volume of water in litres (y)	0	4	8	12	16	20	24	28

a) On your own set of axes, draw a scatter plot of Holly's results above.
b) Draw a line of best fit on the graph.
c) Calculate the equation of the line of best fit.
d) Use the equation to predict how many litres of water are wasted in a leaking toilet in one day.

Solutions to Exercise 2 number 3 are on page **389**

Measure of Central Tendency (from pages 217 - 220)

Exercise 3:

1) The table below shows the number of minutes that Lebo spends on her cell phone messaging her friends over a 7-day period. Determine Lebo's:

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Time (min)	35	30	39	35	35	22	42

a) Mean time.
b) Median time.
c) Modal time.

Solutions to Exercise 3 number 1*a* are on page **389** and number 1*b* and *c* are on page **390**

2) The table below shows the heights of a grade 9 class in centimetres.

157	155	142	148	160	157	158	157	159	154
153	161	163	144	148	149	155	154	160	152

a) Determine the mean height of the class.
b) Determine the modal height of the class.
c) Fill in the frequency table below:

Interval	Frequency f	Midpoint x	Frequency × Midpoint $f \times x$
140 – 144			
145 – 149			
150 – 154			
155 – 159			
160 – 164			

Total Frequency: ____________ Sum: ____________

d) Use the frequency table to calculate the estimated mean height of the class.
e) Use the frequency table to determine an estimate of the mode for the class.
f) Explain the reason for any differences in your answers for the mean using the frequency table compared to your answer in *a*) above.

Solutions to Exercise 3 number 2 are on page **390**

3) The time, in seconds, taken for 40 Grade 9 learners to complete a maths task are shown in the table below:

152	154	167	146	123	166	152	152	123	133
175	147	156	141	162	131	151	161	131	162
141	153	122	132	141	157	148	158	162	179
139	147	158	122	123	133	140	144	152	133

a) Copy and complete the table below:

Interval	Tally	Frequency
120 – 129		
130 – 139		
140 – 149		
150 – 159		
160 – 169		
170 – 179		

b) Use your table to draw a histogram of the above data.
c) Determine the mean of the data using the information in the table above.
d) Use the frequency table to determine an estimated mean of the grouped data. (Hint: Add two columns to the table.)
e) Why does your answer in c) differ from your answer obtained in d) above?

Solutions to Exercise 3 number 3*a* and *b* are on page **390** and *c* to *e* are on page **391**

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Measures of Dispersion (from pages 221 - 224)

Exercise 4:

1) Examine each set of data given below:

Data Set 1	0	3	3	5	7	7	8	9	11	14

Data Set 2	1	1	1	2	2	5	6	9	11	12	13	14	15

Data Set 3	3	3	5	11	16	19	20	23	26

Data Set 4	1	2	2	2	4	7	7	11	13	16	17	17	25	28

For each set of data, determine the:

a) Median.
b) Lower and upper quartiles.
c) Range and the inter-quartile range.

Solutions to Exercise 4 number 1 are on page **391**

2) Given the data below, determine the:

20	34	26	21	25	35	17	17	15	29	18
28	23	36	26	15	33	18	17	28	22	32

a) Median.
b) Lower and upper quartiles.
c) Range and the inter-quartile range.

Solutions to Exercise 4 are on page **392**

3) The table below shows the number of runs scored by a cricketer in his last ten matches:

19	39	54	0	102	5	15	39	57	3

a) Determine the median number of runs scored.
b) Determine the lower and upper quartiles for the data.
c) Determine the range and the inter-quartile range for the data above.
d) If the cricket coach were to analyse the above data, would the range be a good measure of dispersion for him to use? Explain your answer.

Solutions to Exercise 4 number 3 are on page **392**

4) The marks out of 100 that each person obtained in a maths test are shown below. Alex obtained a mark of A, and Lerato obtained a mark of L. Alex's mark is the lower quartile and Lerato's mark is the upper quartile.

48	68	50	64	53	61	59	70	70	93	72
91	75	75	77	84	88	**L**	**A**			

a) Determine the **position** of the median mark.
b) Determine the **position** of the lower and upper quartile marks.
c) Determine the value of A, the mark which Alex obtained, if Alex's mark was unique in the class. (Assume that all marks are integer values).
d) If the interquartile range of the class is 19, determine the mark that Lerato achieved.

Solutions to Exercise 4 number 4 are on page **392**

5) In a Grade 9 Mathematics class test, 15 people did better than Ridhwaan and 15 people did worse than him. Answer true or false to the following statements. If the statement is false, correct the statement.

a) Ridhwaan's mark is the lower quartile.
b) There are 30 people in the class.
c) The median is in position 15.
d) The lower quartile is in position 7.
e) It is not possible to determine the range from the given information.
f) The upper quartile is in position 23.

Solutions to Exercise 4 number 5 are on page **392**

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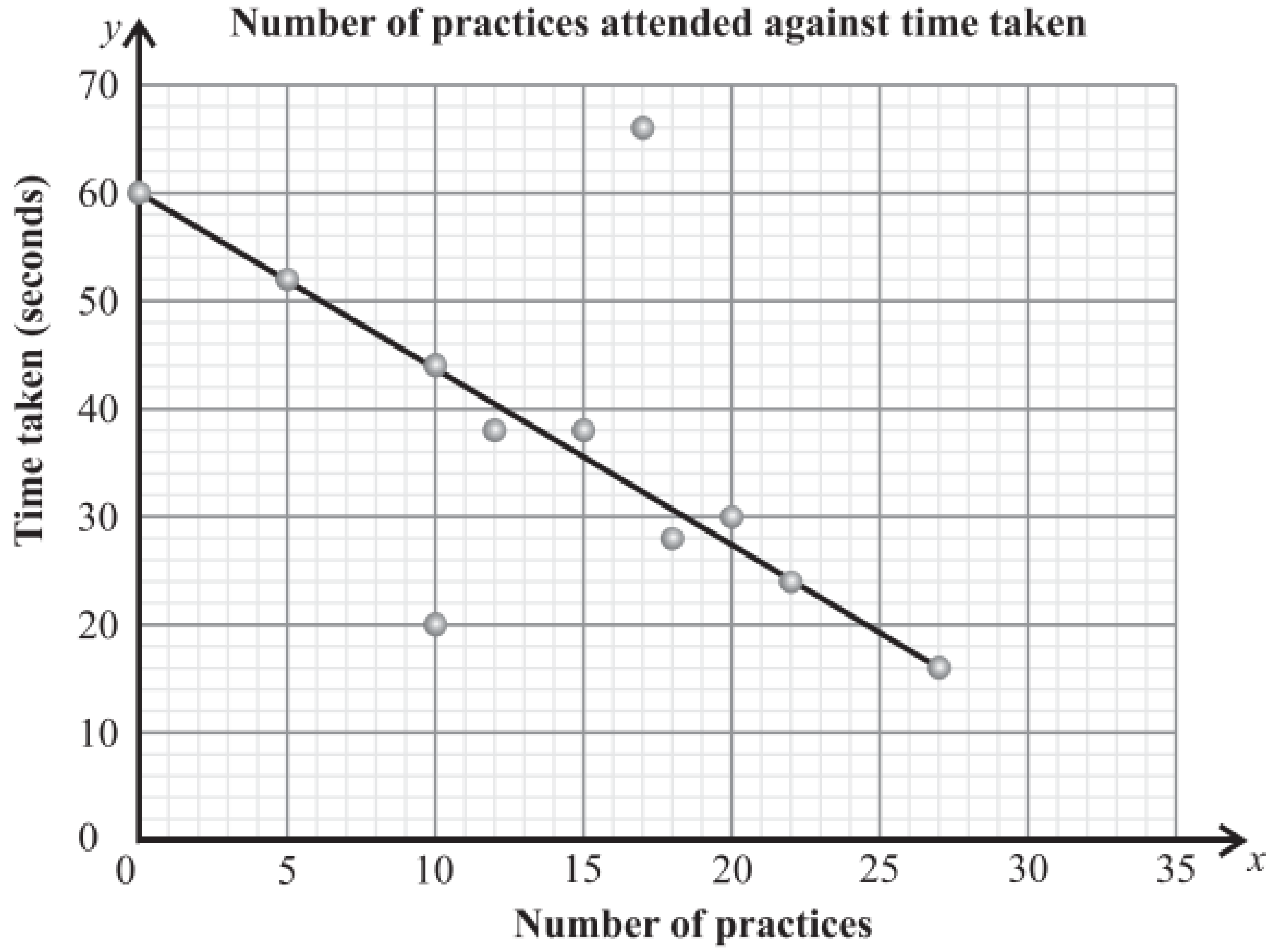
The Mixed Exercise

1) The scatter plot below shows the number of athletic practises attended by members of an athletics team, against their times taken to run a race.



a) How many people participated in the race?
b) Determine the mean time.
c) Determine the median time
d) Determine the upper and lower quartile times.
e) Are there any outliers? If so give the coordinates of the outliers in the form (number of practices ; time).
f) Describe the strength of the relationship between the variables.
g) If an athlete attended 16 practices, how long would you expect it to take him or her to complete the race?
h) The coach of the athletic team must select one runner to represent the club in a race in 6 months' time. Which athlete should he select?

Solutions to the Mixed Exercise number 1 are on page **393**

2) A set of data contains 5 values.

- **The largest value in the data set is 20**
- **The range of the data is 15**
- **The upper quartile is greater than the mode**
- **The mode is 10**
- **The mean of the data set is 12**

Use the information above to fill in the table below:

Lowest Value	Lower Quartile	Median	Upper Quartile	Highest Value

Solutions to the Mixed Exercise number 2 are on page **393**

3) In a study, thirteen drivers were asked to press the brake pedal in a car when they see a red light turn on. Their reaction times (in seconds) are shown below:

2,4 3,1 2,6 4,1 2,5 2,3 1,8 2,5 3 2,5

2,9 2,2 2,1

a) What is the average reaction time of the drivers?
b) Determine the median reaction time.
c) Determine the lower and upper quartiles.
d) Determine range and inter-quartile range.
e) The drivers then underwent a training exercise and were retested. Five of the drivers improved their reaction times by 0,2 seconds. What is the new mean?

Solutions to the Mixed Exercise number 3 are on page **393**

4) The mean of 10 numbers is 8. An eleventh number is added to these numbers and the new mean is 12. What number was added?

Solutions to the Mixed Exercise number 4 are on page **393**

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5) In a biology experiment the heights (in cm) of 40 plants were recorded and the results are shown below:

22	16	29	38	60	51	44	33	72	19
35	24	33	40	44	42	52	33	76	74
24	33	41	46	29	33	28	38	67	44
41	52	52	31	68	65	55	41	55	48

a) Arrange the data using a stem and leaf diagram.
b) What is the range of the heights?
c) 50% of the plants were below a certain height. What is this height called and what is its value?
d) Determine the lower and upper quartiles.
e) Determine the mean of the plant heights.
f) Fill in the table below:

Height (cm)	Frequency f	Midpoint x	Frequency × Midpoint $f \times x$
1 – 10			
11 – 20			
21 – 30			
31 – 40			
41 – 50			
51 – 60			
61 – 70			
71 – 80			
Total frequency =		Sum of $f \times x$ =	

g) Determine the estimated mean using your table.
Solutions to the Mixed Exercise number 5 are on page **394**

6) The mean of 5 numbers is 13. One of the numbers is 10. If 10 is removed and replaced by the number 18, what will the new mean be?
Solutions to the Mixed Exercise number 6 are on page **394**

7) In a school, there are two Grade 9 French classes. Grade 9A has 12 learners in it and Grade 9B has 15. In a test Grade 9A's average was 75% and Grade 9B's average was 68%. What is the overall average for both classes?
Solutions to the Mixed Exercise number 7 are on page **394**

8) The marks which 5 boys achieved in a test out of 40 are shown below:

20	**26**	**28**	**30**	**36**

a) Determine the groups average. Give your answer as a percentage.
b) If a boy received 65% in the test, what mark did he get out of 40?
c) Another boy is added to the group and the new average is 65%. What was his mark out of 40?
Solutions to the Mixed Exercise number 8 are on page **394**

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Chapter 20 – Data Handling (Solutions)

Exercise 1 Solutions:

1)

a) 70 **b)** 45 **c)** Grade 10 **d)** 5 **e)** 384

Exercise 1 number 1 is on page **382**

2)

a)

Boys	Stem	Girls
	14	5 8
9	15	4 6 9
7 7 6 6	16	0 1 2 3 5 5 7
9 8 7 5 5 4	17	2 2 3
8 7 5 4 3	18	
Key: 14|5 represents the number 145		

b)

Interval	Boys	Girls
140 – 149	0	2
150 – 159	1	3
160 – 169	4	7
170 – 179	6	3
180 – 189	5	0

c) 188cm

d) 5 girls

e) 15 boys

Exercise 1 number 2 is on page **382**

3)

a) $360° - 36° - 216° - 90°$
$= 18°$

b) $\text{Number of A's} = \frac{18^\circ}{360^\circ} \times 200$
$= 10$

c) $\text{\% of B's} = \frac{216^\circ}{360^\circ} \times 100\%$
$= 60\%$

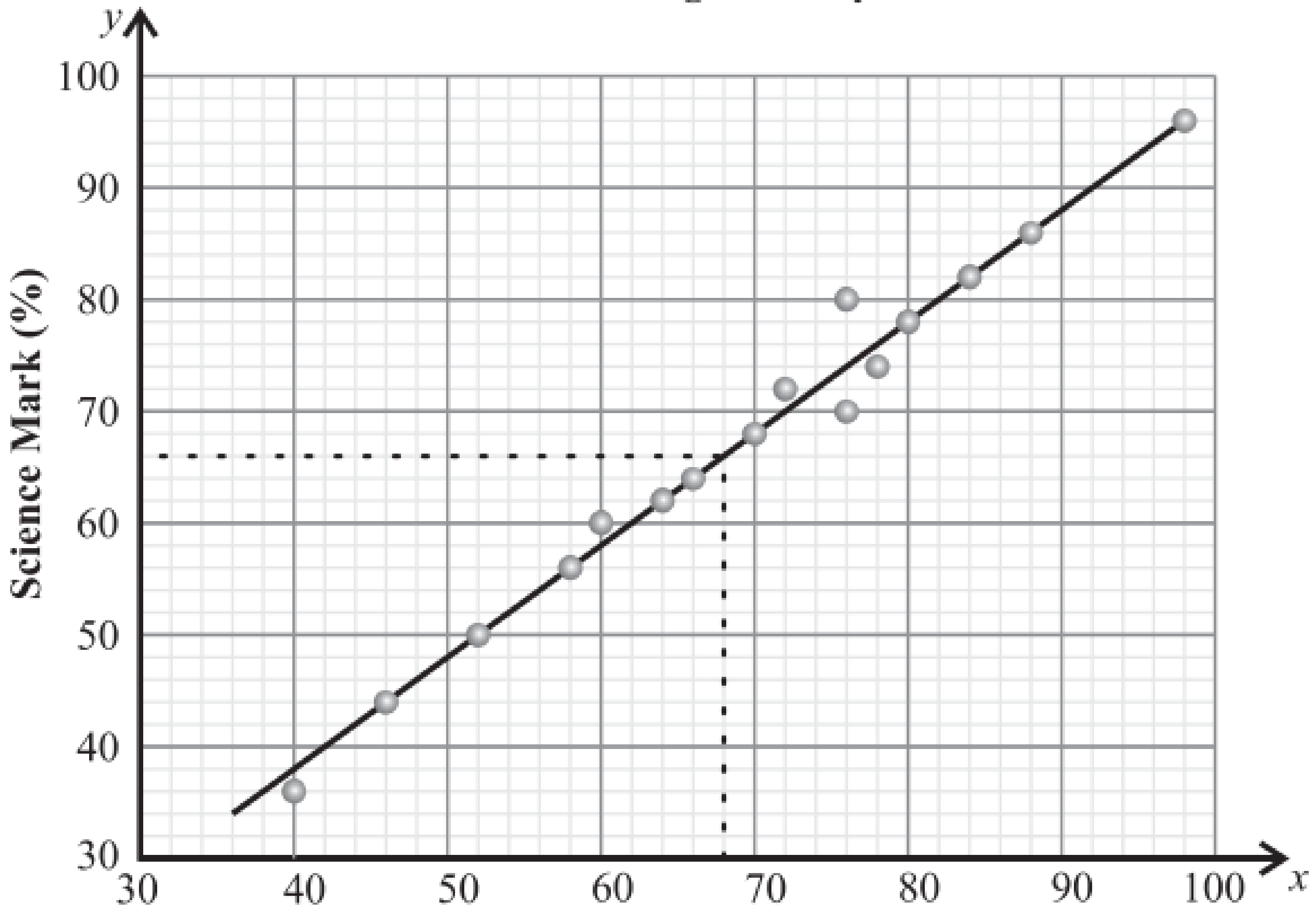
Exercise 1 number 3 are on page **382**

Exercise 2 Solutions:

1)

a)

Grade 9 Mathematics marks against Physical Science marks



b) Shown on the graph above.

c) The graph shows a strong, positive, linear trend.

d) By reading off the line of best fit, a learner who achieved 68% for Maths would obtain **66% for science.**

Exercise 2 number 1 is on page **383**

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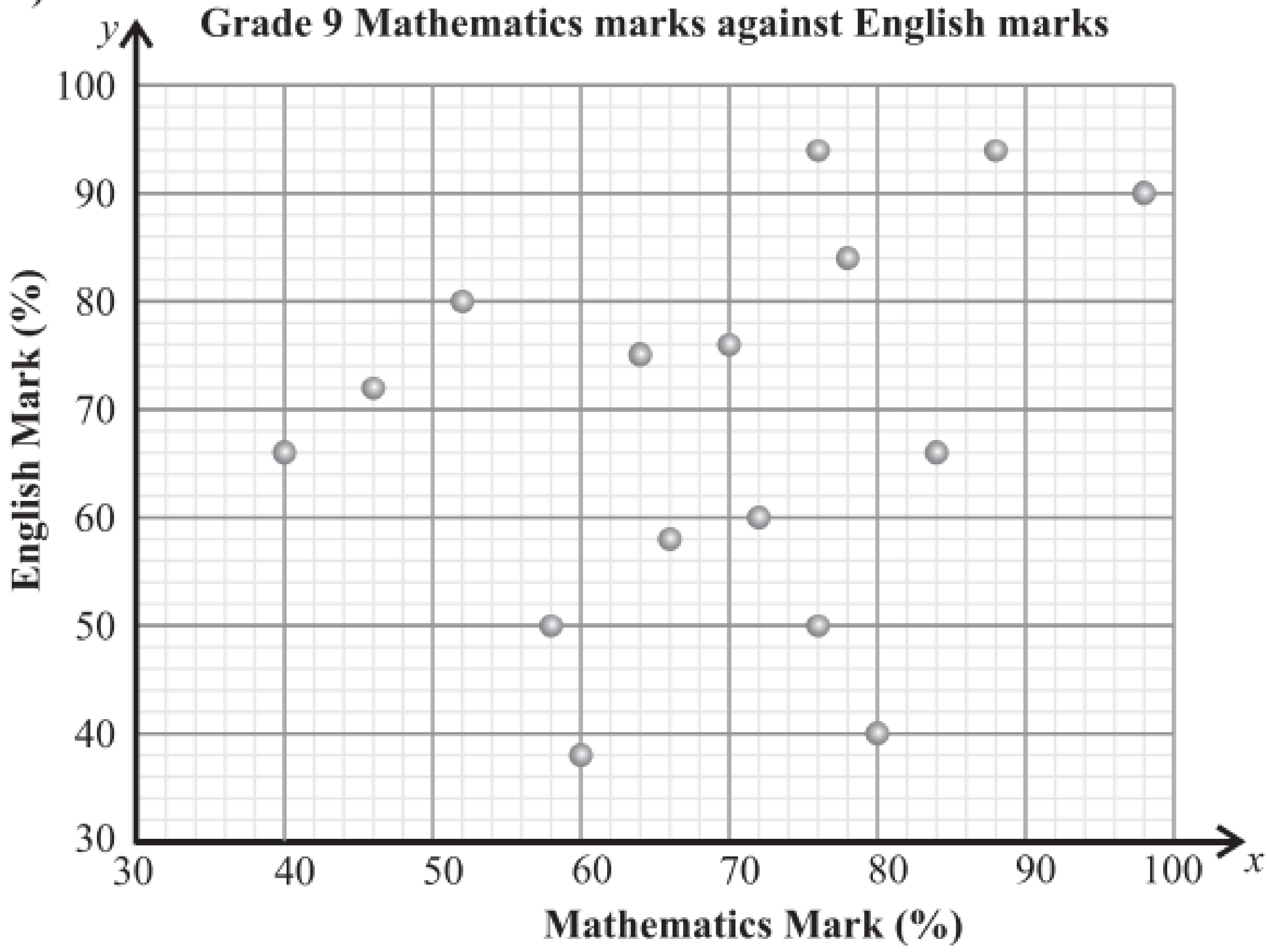
2)

a)



b) There is no trend in the data.

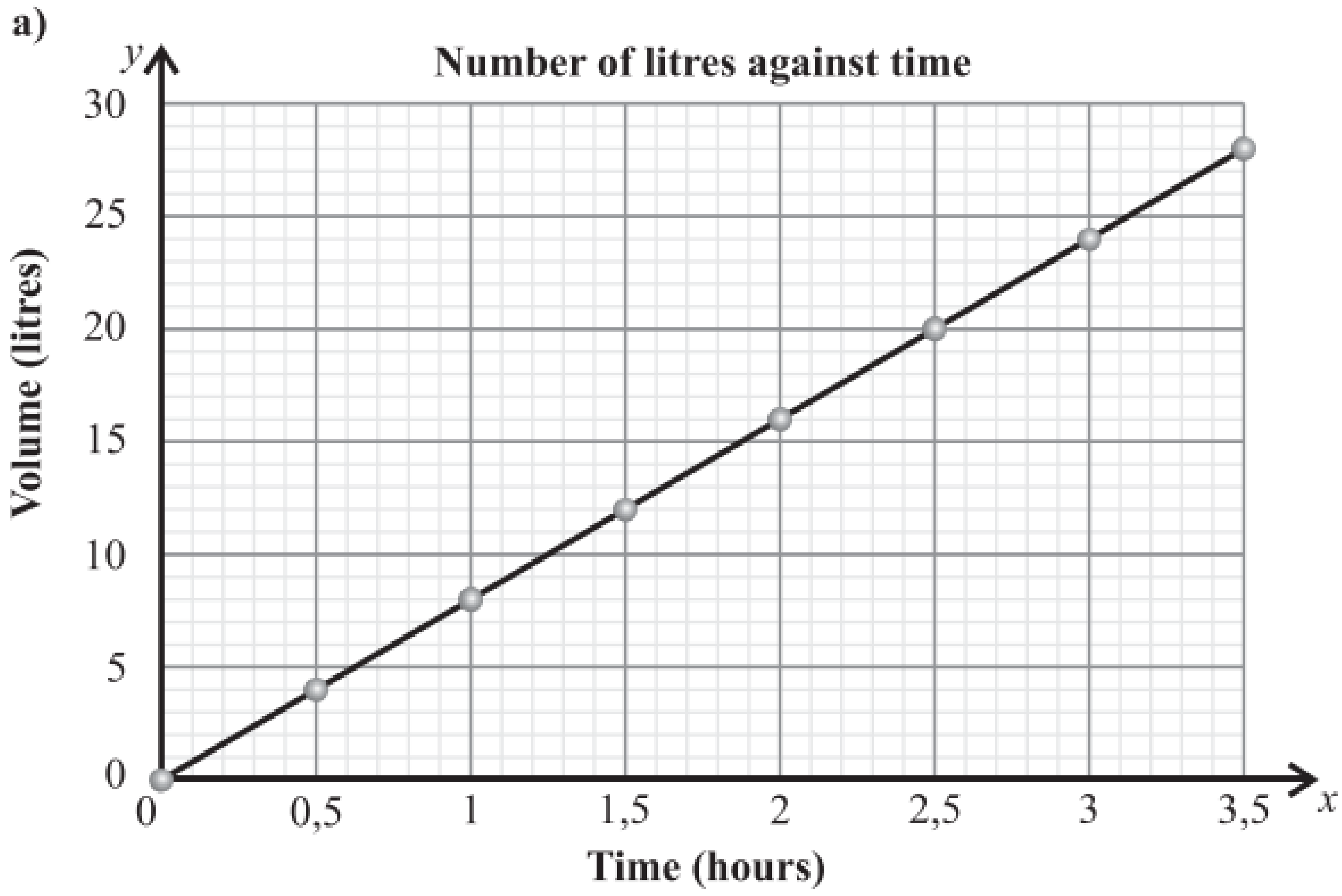
c) No, a line of best fit shows the trend which a set of data follows. As there is no trend to the data, a line of best fit will not show any relationship in the English and Mathematics marks.

d) No, there is no relationship that can be established in the graph.

Exercise 2 number 2 is on page 383

3)

a)



b) Shown on the graph above.

c) $y = mx + 0 \rightarrow$ the y-intercept is 0

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4-0}{0,5-0} = 8 \rightarrow \text{any two points could have been used to calculate the gradient}$$

$\therefore y = 8x$

d) $y = 8(24)$

$= 192$ litres per day

Exercise 2 number 3 is on page 384

Exercise 3 Solutions:

1)

a) Mean $= \dfrac{35+30+39+35+35+22+42}{7}$

$= 34$ minutes

Exercise 3 number 1 is on page 384 solutions are continued on the next page.

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b) The data must first be ordered:

Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7
22	30	35	35	35	39	42

$$\text{Position of median} = \frac{7+1}{2} = 4$$

$\therefore$ the median time is 35 minutes

c) 35 minutes

Exercise 3 number 1 is on page **384**

2)

a) $\text{mean} = \frac{3086}{20} = 154{,}3\,\text{cm}$

b) 157 cm

c)

Interval	Frequency f	Midpoint x	Frequency × Midpoint $f \times x$
140 – 144	**2**	**142**	**284**
145 – 149	**3**	**147**	**441**
150 – 154	**4**	**152**	**608**
155 – 159	**7**	**157**	**1099**
160 – 164	**4**	**162**	**648**
Total Frequency:	**20**	Sum:	**3080**

d) $\text{Estimated mean} = \frac{3080}{20} = 154\text{cm}$

e) The estimated mode will be the midpoint of the modal class (155 – 159). Therefore, from the frequency table the mode is **157cm**.

f) The answer in a) is obtained by adding each individual height and dividing by the total number of people. This provides the exact mean (average). The answer in d) is obtained by assuming that all the people in each interval had a height equal to the midpoints of the interval. This provides an estimate of the mean.

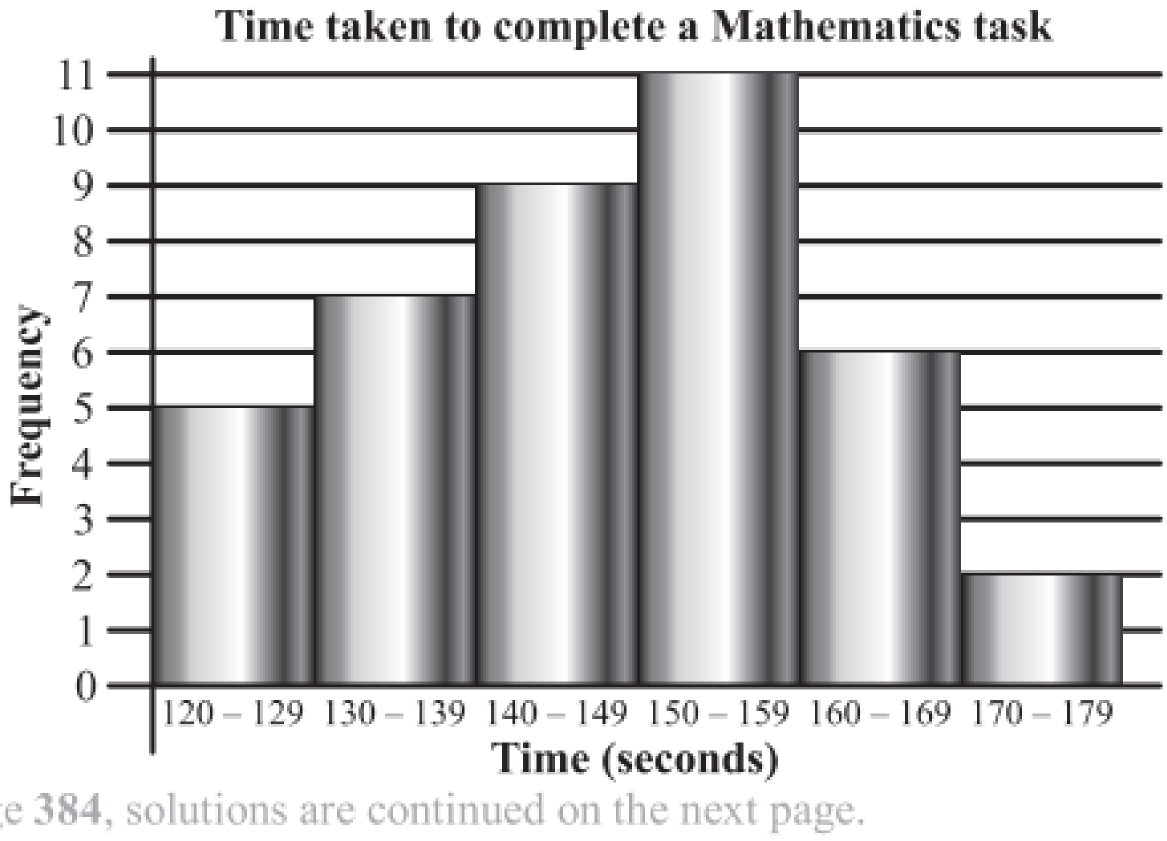
Exercise 3 number 2 is on page **384**

3)

a)

Interval	Tally	Frequency	Midpoint	Frequency ×Midpoint
120 – 129	𝍸	5	124,5	622,5
130 – 139	𝍸 𝍷𝍷	7	134,5	941,5
140 – 149	𝍸 𝍷𝍷𝍷𝍷	9	144,5	1 300,5
150 – 159	𝍸 𝍸 𝍷	11	154,5	1 699,5
160 – 169	𝍸 𝍷	6	164,5	987
170 – 179	𝍷𝍷	2	174,5	349
Total Frequency:		40	Sum:	5 900

b)



Exercise 3 number 3 is on page **384**, solutions are continued on the next page.

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c) Sum of data in original table $= 5869$

$$\therefore \text{Mean} = \frac{5869}{40}$$
$$= 146,73 \text{ seconds}$$

d) Estimated mean $= \dfrac{5900}{40}$

$$= 147,5 \text{ seconds}$$

e) The answer in c) is obtained by adding each individual time and dividing by the total number of people. This provides the exact mean (average).
The answer in d) is obtained by assuming that all the people in each interval had a time equal to the midpoints of the interval. This provides an estimate of the mean and as can be seen from the above answers, is very close to the actual mean. This is more practical for very large sets of data.

Exercise 3 number 3 is on page **384**

<u>Exercise 4 Solutions</u>:

1)
a)

Data set 1: position of median $= \dfrac{10+1}{2} = 5,5$

$\therefore$ median $= \dfrac{7+7}{2} = 7$

Data set 2: position of median $= \dfrac{13+1}{2} = 7$

$\therefore$ median $= 6$

Data set 3: position of median $= \dfrac{9+1}{2} = 5$

$\therefore$ median $= 16$

Data set 4: position of median $= \dfrac{14+1}{2} = 7,5$

$\therefore$ median $= \dfrac{7+11}{2} = 9$

b)

Data set 1: position of $Q_1 = \dfrac{5+1}{2} = 3$ position of $Q_3 = 5+3 = 8$

$\therefore Q_1 = 3$ $\therefore Q_3 = 9$

Data set 2: position of $Q_1 = \dfrac{6+1}{2} = 3,5$ position of $Q_3 = 7+3,5 = 10,5$

$\therefore Q_1 = \dfrac{1+2}{2} = 1,5$ $\therefore Q_3 = \dfrac{12+13}{3} = 12,5$

Data set 3: position of $Q_1 = \dfrac{4+1}{2} = 2,5$ position of $Q_3 = 5+2,5 = 7,5$

$\therefore Q_1 = \dfrac{3+5}{2} = 4$ $\therefore Q_3 = \dfrac{20+23}{2} = 21,5$

Data set 4: position of $Q_1 = \dfrac{7+1}{2} = 4$ position of $Q_3 = 7+4 = 11$

$\therefore Q_1 = 2$ $\therefore Q_3 = 17$

c)

Data set 1: Range $= 14-0 = 14$ IQR $= 9-3 = 6$

Data set 2: Range $= 15-1 = 14$ IQR $= 12,5-1,5 = 11$

Data set 3: Range $= 26-3 = 23$ IQR $= 21,5-4 = 17,5$

Data set 4: Range $= 28-1 = 27$ IQR $= 17-2 = 15$

Exercise 4 number 1 is on page **385**

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2) You first must write the data in order:

15	15	17	17	17	**18**	18	20	21	22	23	25	26	26	28	28	**29**	32	33	34	35	36

a) position of median $= \frac{22+1}{2} = 11,5$

$\therefore$ Median $= \frac{23+25}{2} = 24$

b) position of $Q_1 = \frac{11+1}{2} = 6$ position of $Q_3 = 11+6 = 17$

$\therefore Q_1 = 18$ $Q_3 = 29$

c) Range $= 36 - 15 = 21$ IQR $= 29 - 18 = 11$

Exercise 4 number 2 is on page **385**

3) You must first write the data in order:

0	3	**5**	15	19	39	39	**54**	57	102

a) position of median $= \frac{10+1}{2} = 5,5$

$\therefore$ Median $= \frac{19+39}{2} = 29$ runs

b) position of $Q_1 = \frac{5+1}{2} = 3$ position of $Q_3 = 5+3 = 8$

$\therefore Q_1 = 5$ $Q_3 = 54$

c) Range $= 102 - 0 = 102$ IQR $= 54 - 5 = 49$

d) No, there are outliers in this set of data which would skew the range.

Exercise 4 number 3 is on page **385**

4)

a) position of median $= \frac{19+1}{2} = 10$

b) position of $Q_1 = \frac{9+1}{2} = 5$ position of $Q_3 = 10+5 = 15$

c) Arrange the data in order with Alex in position 5 and Lerato in position 15:

48	50	53	59	**A**	61	64	68	70	70	72	75	75	77	**L**	84	88	91	93

As Alex's mark is unique (no other person in the class got the same mark) and an integer (no decimals) Alex's mark must be **60**.

d) IQR $= L - A$

$\therefore 19 = L - 60$

$\therefore L = 79$

Exercise 4 number 4 is on page **385**

5)

a) False, his mark is the median.

b) False, there are 31 people in the class.

c) False, the median is in position 16.

d) False, the lower quartile is in position 8.

e) True.

f) False, the upper quartile is in position 24.

Exercise 4 number 5 is on page **385**

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The Mixed Exercise Solutions:

1)

a) 11

b) mean $= \frac{16+20+24+28+30+38+38+44+52+60+66}{11} = 37,82\,\text{s}$

c) position of median $= \frac{11+1}{2} = 6$

$\therefore$ Median = 38s

d) position of $Q_1 = \frac{5+1}{2} = 3$ position of $Q_3 = 6+3 = 9$

$\therefore Q_1 = 24\,\text{s}$ $Q_3 = 52\,\text{s}$

e) $(10;20)$ and $(17;66)$

f) Strong, negative, linear relationship.

g) Reading from the line of best fit, it would take him or her **34 seconds** to complete the race.

h) The athlete that completed the race in 20 seconds and only attended 10 practises. Although he wasn't the fastest, he came second and only attended 10 practises. If he trains more he would most likely be the fastest athlete.

The Mixed Exercise number 1 is on page **386**

2)

- Highest value = 20
- 20 – lowest value = 15
  $\therefore$ lowest value = 5
- There are two values = 10 and one is not upper quartile. Therefore, Q_1 and Q_2 are both 10.
  $\frac{5+10+10+Q_3+20}{5} = 12$
- $\therefore Q_3 + 45 = 60$
  $\therefore Q_3 = 15$

Lowest Value	Lower Quartile	Median	Upper Quartile	Highest Value
5	**10**	**10**	**15**	**20**

The Mixed Exercise number 2 is on page **386**

3)

a) mean $= \frac{2,4+3,1+2,6+4,1+2,5+2,3+1,8+2,5+3+2,5+2,9+2,2+2,1}{13} = \frac{34}{13} = \mathbf{2,62\,s}$

b) First write the data in order:

1,8	2,1	**2,2**	**2,3**	2,4	2,5	**2,5**	2,5	2,6	**2,9**	**3**	3,1	4,1

position of median $= \frac{13+1}{2} = 7$

$\therefore$ Median $= 2,5\,\text{s}$

c) position of $Q_1 = \frac{6+1}{2} = 3,5$ position of $Q_3 = 7+3,5 = 10,5$

$\therefore Q_1 = \frac{2,2+2,3}{2} = 2,25\,\text{s}$ $Q_3 = \frac{2,9+3}{2} = 2,95\,\text{s}$

d) Range $= 4,1-1,8 = 2,3\,\text{s}$ IQR $= 2,95-2,25 = 0,7\,\text{s}$

e) new mean $= \frac{34-5(0,2)}{13} = \frac{33}{13} = \mathbf{2,54\,s}$

The Mixed Exercise number 3 is on page **386**

4) $\frac{\text{sum of the numbers}}{10} = 8$

$\therefore$ sum of the numbers = 80

$\frac{80+x}{11} = 12$

$\therefore 80 + x = 132$

$\therefore x = 52$

The Mixed Exercise number 4 is on page **387**

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5)

a)

Stem	Leaf
1	6 9
2	2 4 4 8 9 9
3	1 3 3 3 3 3 5 8 8
4	0 1 1 1 2 4 4 4 6 8
5	1 2 2 2 5 5
6	0 5 7 8
7	2 4 6
Key: 1|6 = 16	

b) $\text{Range} = 76 - 16 = 60\,\text{cm}$

c) $\text{Median} = \dfrac{41+41}{2} = 41\,\text{cm} \rightarrow \text{position of median} = \dfrac{40+1}{2} = 20,5$

d) $\text{position of } Q_1 = \dfrac{20+1}{2} = 10,5$ $\quad$ $\text{position of } Q_3 = 20 + 10,5 = 30,5$

$\therefore Q_1 = \dfrac{33+33}{2} = 33\,\text{cm}$ $\quad$ $Q_3 = \dfrac{52+52}{2} = 52\,\text{cm}$

e) $\text{mean} = \dfrac{1728}{40} = 43,2\,\text{cm}$

f)

Time	Frequency f	Midpoint x	Frequency × Midpoint $f \times x$
1 – 10	0	**5,5**	0
11 – 20	2	**15,5**	31
21 – 30	6	**25,5**	153
31 – 40	9	**35,5**	319,5
41 – 50	10	**45,5**	455
51 – 60	6	**55,5**	333
61 – 70	4	**65,5**	262
71 – 80	3	**75,5**	226,5
Total frequency =	**40**	Sum of $f \times x$ =	**1 780**

g) $\text{Estimated mean} = \dfrac{1780}{40}$

$= 44,5\,\text{cm}$

The Mixed Exercise number 5 is on page **387**

6) $\dfrac{\text{sum of numbers}}{5} = 13$

$\therefore \text{sum of numbers} = 65$

$\text{new mean} = \dfrac{65 - 10 + 18}{5} = 14,6$

The Mixed Exercise number 5 is on page **387**

7) 9A: $\dfrac{\text{sum of percentages}}{12} = 75$

$\text{sum of percentages} = 900$

9B: $\dfrac{\text{sum of percentages}}{15} = 68$

$\text{sum of percentages} = 1020$

$\text{Grade average} = \dfrac{900 + 1020}{12 + 15}$

$= 71,11\%$

The Mixed Exercise number 7 is on page **387**

8)

a) $\text{mean} = \dfrac{20+26+28+30+36}{5} = 28 \rightarrow \text{average mark}$

$\therefore \text{mean } \% = \dfrac{28}{40} = 70\%$

b) $\dfrac{x}{40} \times 100\% = 65\%$

$\therefore x = 26 \text{ out of } 40$

c) $\dfrac{y+20+26+28+30+36}{6} = 26$

$\therefore \dfrac{y+140}{6} = 26$

$\therefore y + 140 = 156$

$\therefore y = 16 \text{ out of } 40$

The Mixed Exercise number 8 is on page **387**

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Chapter 21 – Probability

Grade 8 Revision (from pages 228 - 234)

Exercise 1:

1) A bag contains a total of 30 red and blue balls. If a ball is randomly selected the probability of selecting a blue ball is $\frac{3}{5}$. How many red balls are in the bag?

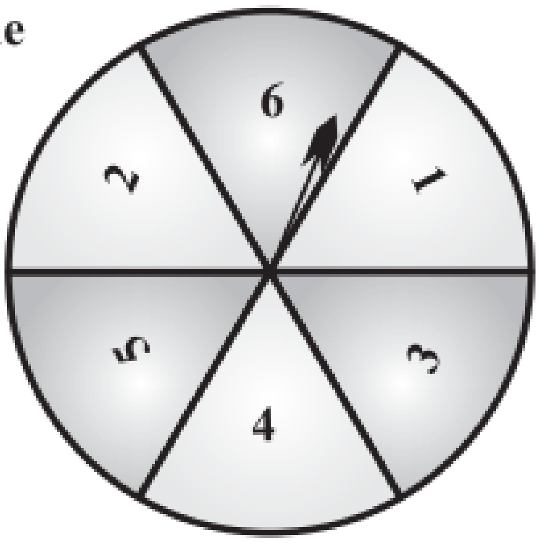
Solutions to Exercise 1 number 1 are on page **398**

2) Eight green balls, five red balls, four yellow balls and three purple balls are placed in a container. If one ball is selected at random, determine the probability of selecting:

a) A red ball
b) A green ball
c) A blue ball
d) A yellow ball
e) A green or red ball
f) A purple or yellow ball
g) A ball that is not purple or green

Solutions to Exercise 1 number 2 are on page **398**

3) The spinner in the diagram alongside is spun once. Calculate the probability of getting:



a) A 1 or a 6
b) An even number
c) An 8
d) An odd number
e) A number less than 6
f) Greater than or equal to 3
g) A number greater than 6
h) A number less than or equal to 1

Solutions to Exercise 1 number 3 are on page **398**

4) A card is randomly drawn from a pack of cards. Determine the probability of selecting a:

a) A red card
b) A black card
c) A picture card (ace, jack, queen or king)
d) A 10
e) A 6 of hearts
f) A card numbered between 5 and 8
g) A red card numbered between 2 and 8
h) A card that is not a 10

Solutions to Exercise 1 number 4 are on page **398**

5) It is twice as likely for event A to occur than it is for event B to occur. If there are no other possibilities, what is the probability of event B occurring?

Solutions to Exercise 1 number 5 are on page **398**

6) The probability of winning a carnival game is 0,08. If the game is played 75 times, how many times would you expect to lose?

Solutions to Exercise 1 number 6 are on page **398**

7) In a sample of 360 people, the probability of selecting a person older than or equal to 40 is $\frac{5}{6}$.

How many people in the sample are under 40 years old?

Solutions to Exercise 1 number 7 are on page **399**

8) In a bag, there are 8 red balls and 2 blue balls. To win a game a contestant must pick two blue balls in a row. Joseph sticks his hand in and pulls out a blue ball. What is the probability that Joseph will win if the blue ball he has already picked is not put back in the bag before he draws another ball?

Solutions to Exercise 1 number 8 are on page **399**

9) The probability that Riaan has a sandwich for lunch on any given day is 0,8.

a) What is the probability that Riaan doesn't have a sandwich for lunch?
b) How many sandwiches would you expect Riaan to have for lunch in 1 month? (assume there are 30 days in a month)

Solutions to Exercise 1 number 9 are on page **399**

Compound Events (from pages 235 - 237)

Exercise 2:

1) In a game show, there are two bags filled with discs that either have the words win or lose written on them. Bag A has 10 discs with the word win and 10 with the word lose. Bag B has 3 discs with the word win and 7 with the word lose. A contestant must randomly select a bag and then draw a disc form it.

a) Draw a tree diagram to show the all the possible outcomes.
b) Determine the probability that a contestant wins.

Solutions to Exercise 2 number 1 are on page **399**

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2) Bongani is trying to decide what outfit to wear to dinner. He looks in his cupboard and sees 3 red shirts, 2 blue shirts and 1 yellow shirt as well as 2 pairs of jeans and 1 pair of casual trousers. Give all answers in decimal form.

a) Draw a tree diagram to assist Bongani in calculating all the different outfits he can wear.
b) If Bongani randomly selects an outfit, what is the probability he will wear a yellow shirt?
c) If Bongani randomly selects an outfit, what is the probability he will wear a blue shirt with trousers?
d) If Bongani randomly selects an outfit, what is the probability he will wear jeans?
e) If Bongani randomly selects an outfit, what is the probability he will not wear a blue shirt?

Solutions to Exercise 2 number 2 are on page **399**

3) Two dice are tossed. Giving all answers as decimals, use a two-way table to determine the probability that the sum of the numbers is:

a) 6
b) Greater than 10
c) Greater than 12
d) less than 5

Solutions to Exercise 2 number 3 are on page **400**

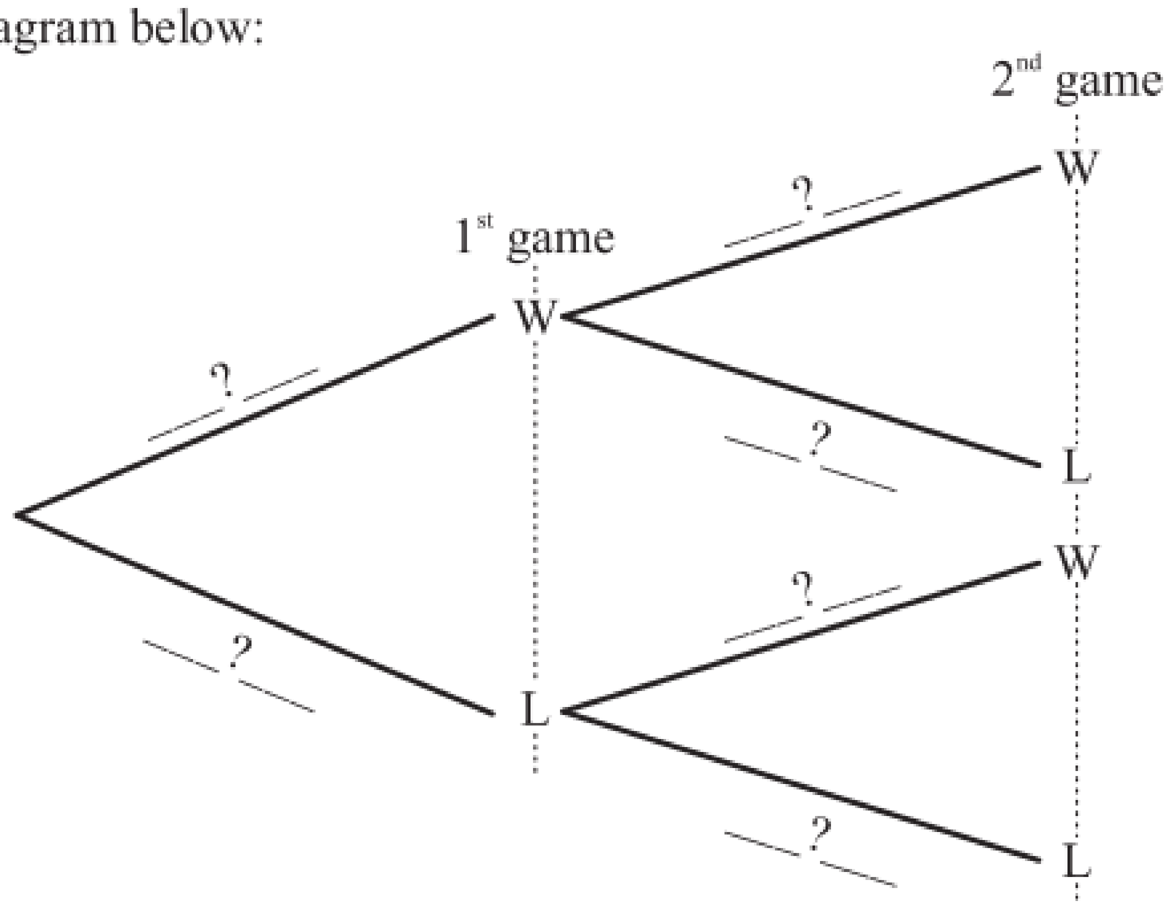
4) A bag contains 5 red balls, 3 blue balls and 2 orange balls. A ball is randomly selected from the bag, its colour noted and placed back in the bag. Another ball is then selected and its colour noted.

a) Draw a two-way table to represent the different possibilities.
b) Draw a tree diagram to represent all the different possibilities.
c) What is the probability that a red ball is selected?
d) What is the probability that two balls of the same colour are selected?
e) What is the probability that a blue or orange ball is selected?

Solutions to Exercise 2 number 4 are on page **400**

5) If a rugby team wins its first game of the season, there is an 80% chance that it will win its second game. If it loses its first game there is 30% chance it will win its second game. There is a 40% chance that the team wins its first game.

a) What is the probability the team loses its first game?
b) Complete the tree diagram below:



c) What is the probability that the team wins both its first and second game?
d) What is the probability the team loses its second game?
e) What is the probability the team wins its second game?

Solutions to Exercise 2 number 5 are on page **401**

6) There is a 25% chance that it will rain on Saturday. If it rains on Saturday there is an 80% chance that it will rain on Sunday. If it doesn't rain on Saturday there is a 10% chance it will rain on Sunday.

a) What is the probability that it doesn't rain on Saturday?
b) Draw a tree diagram to show all the possibilities of rain on Saturday or Sunday.
c) What is the probability that it doesn't rain on Sunday?

Solutions to Exercise 2 number 6 are on page **401**

The Mixed Exercise

1) 4 red balls, 3 blue balls and 13 green balls are placed in a bag and a ball is randomly selected.

a) What is the probability of selecting a green ball?
b) A ball is selected, the colour recorded and the ball is then put back in the bag. How many times would you expect to select a green ball if this process is repeated 60 times?

Solutions to the Mixed Exercise number 1 are on page **401**

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2) A letter from the word MATHEMATICS is randomly chosen. Determine the probability of selecting:

a) The letter M
b) A vowel
c) The letter S
d) A consonant
e) The letter T
f) The letter B
g) The letter I
h) The letters A or E

Solutions to the Mixed Exercise number 2 are on page **401**

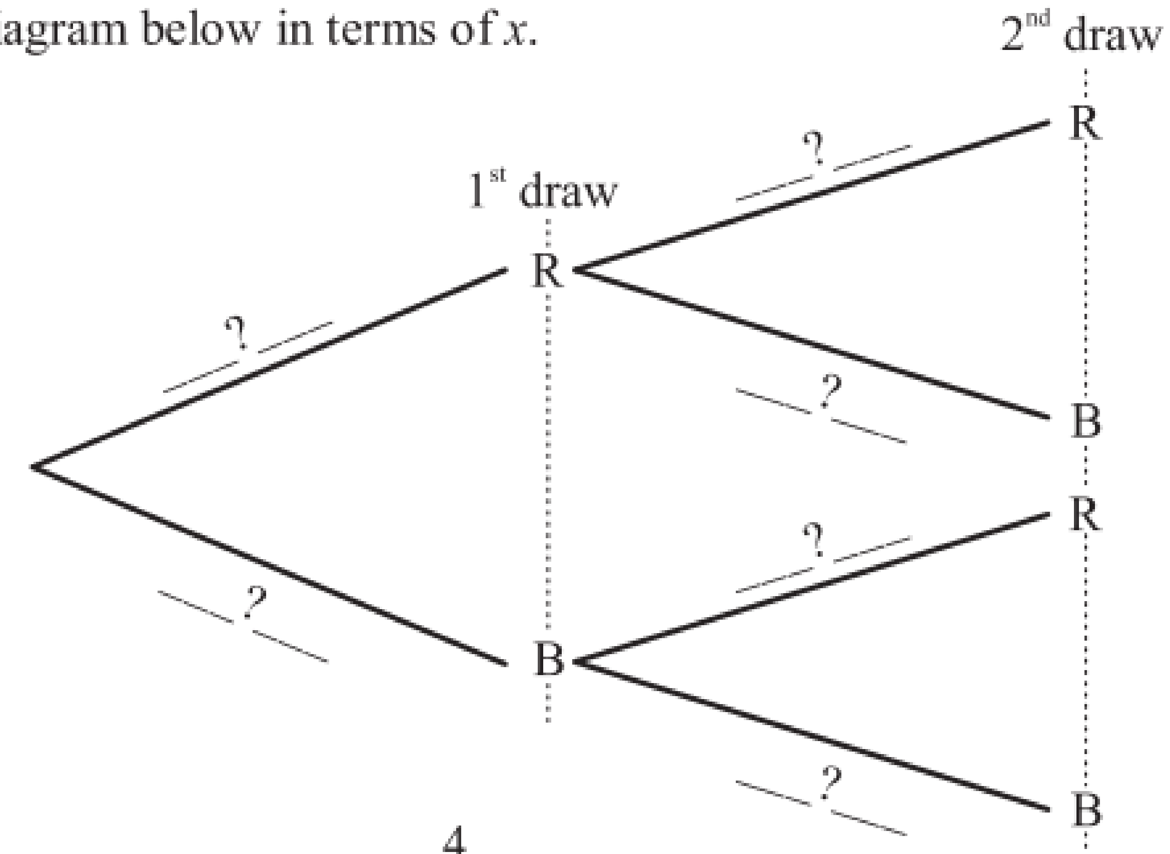
3) One of the games played at Jamie's 8th birthday party is musical chairs. The winner of the game gets to randomly select two prizes from a bag containing 6 chocolates, 10 sweets and 4 cereal bars.

a) Draw a tree diagram to represent all the possibilities.
b) What is the probability that the winner will pick a chocolate and a sweet?
c) What is the probability that the winner selects two of the same type of prize?

Solutions to the Mixed Exercise number 3 are on page **402**

4) A bag contains 10 red balls and x blue balls. A ball is randomly selected, its colour noted and then placed back in the bag. Another ball is then randomly selected from the bag.

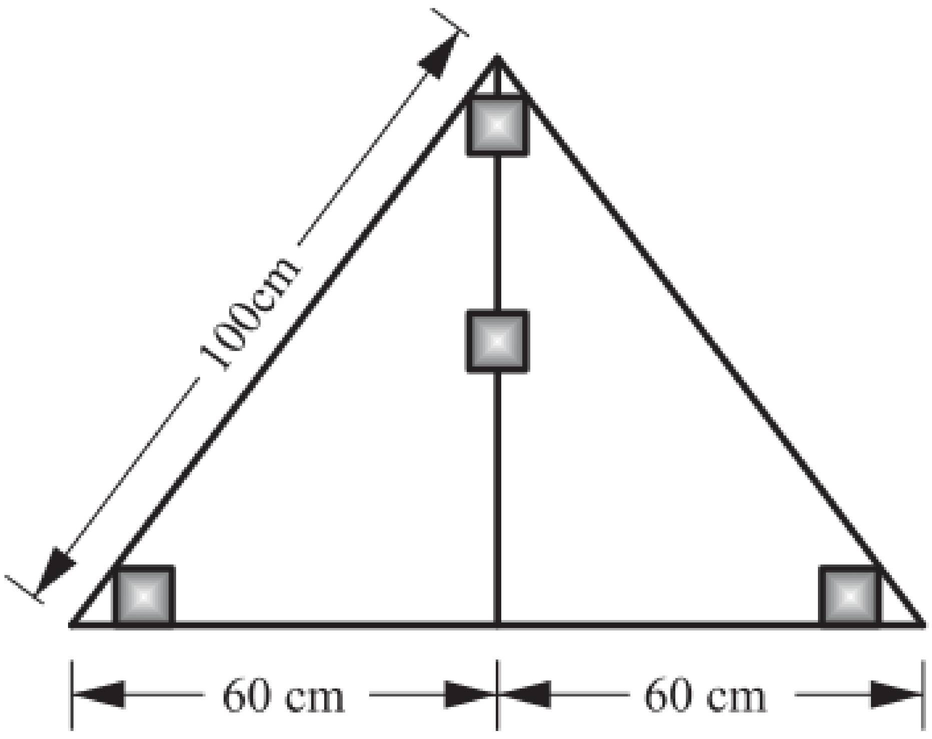
a) Write down the number of balls in the bag in terms of x.
b) What is the probability of selecting a red ball on a single draw? Give your answer in terms of x.
c) What is the probability of selecting a blue ball on a single draw? Give your answer in terms of x.
d) Complete the tree diagram below in terms of x.



e) The probability of selecting 2 red balls is $\frac{4}{9}$. How many blue balls are in the bag?

Solutions to the Mixed Exercise number 4 are on page **402**

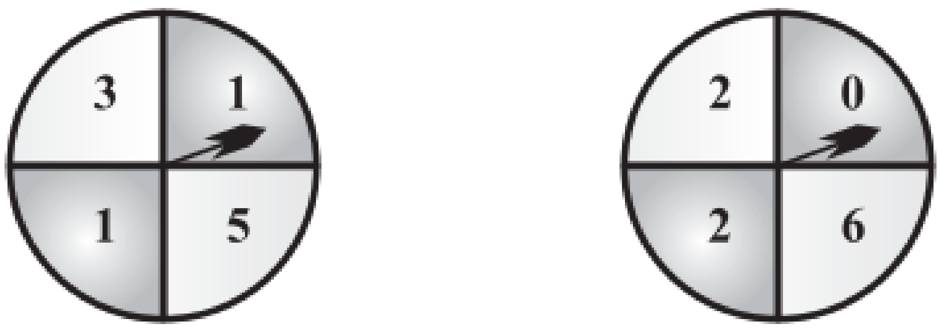
5) At a school Fun Day, the triangular board shown alongside is used in a game. A player stands on a ladder and drops a R5 coin onto the board. If the coin lands in a shaded square, the player gets his money back and wins a prize. If the coin lands anywhere else in the triangle, the player loses and the R5 goes towards the schools fundraising.



a) What is the area of the triangular board?
b) The probability of wining is 0,03. If the shaded squares are identical, what are the dimensions of each shaded square?

Solutions to the Mixed Exercise number 5 are on page **403**

6) The two spinners shown below are spun and their numbers are added together to generate random numbers.



Spinner 1 **Spinner 2**

a) What is the largest and smallest number that can be generated?
b) Draw a two-way table to represent all the possible outcomes.
c) What is the probability the result is a 5 or larger?
d) What is the probability that the first spinner lands on 3?
e) What is the probability that both spinners land on the same number?
f) What is the probability of spinner 1 landing on 5 and spinner 2 landing on a 2?

Solutions to the Mixed Exercise number 5 are on page **403**

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Chapter 21 – Probability (Solutions)

Exercise 1 Solutions:

1) $P(\text{red}) = \frac{2}{5}$

Number of red balls $= 30 \times \frac{2}{5}$

$= 12$

Exercise 1 number 1 is on page 395

2)

a) $P(\text{red}) = \frac{5}{20} = \frac{1}{4} = 0,25$

b) $P(\text{green}) = \frac{8}{20} = \frac{2}{5} = 0,4$

c) $P(\text{blue}) = \frac{0}{20} = 0$

d) $P(\text{yellow}) = \frac{4}{20} = \frac{1}{5} = 0,2$

e) $P(\text{G or R}) = \frac{8+5}{20} = \frac{13}{20} = 0,65$

f) $P(\text{P or Y}) = \frac{3+4}{20} = \frac{7}{20} = 0,35$

g) $P(\text{not P or G}) = 1 - P(\text{P or G})$

$= 1 - \frac{3+8}{20} = \frac{9}{20} = 0,45$

Exercise 1 number 2 is on page 395

3)

a) $P(1 \text{ or } 6) = \frac{2}{6} = \frac{1}{3} = 0,33$

b) $P(\text{even}) = \frac{3}{6} = \frac{1}{2} = 0,5$

c) $P(8) = \frac{0}{8} = 0$

d) $P(\text{odd}) = \frac{3}{6} = \frac{1}{2} = 0,5$

e) $P(\text{less than } 6) = \frac{5}{6} = 0,83$

f) $P(\text{greater than or equal to } 3) = \frac{4}{6} = \frac{2}{3} = 0,67$

g) $P(\text{greater than } 6) = \frac{0}{6} = 0$

h) $P(\text{less than or equal to } 1) = \frac{1}{6} = 0,17$

Exercise 1 number 3 is on page 395

4)

a) $P(\text{red}) = \frac{26}{52} = \frac{1}{2} = 0,5$

b) $P(\text{black}) = \frac{26}{52} = \frac{1}{2} = 0,5$

c) $P(\text{picture}) = \frac{16}{52} = \frac{4}{13} = 0,31$

d) $P(10) = \frac{4}{52} = \frac{1}{13} = 0,08$

e) $P(6 \text{ of hearts}) = \frac{1}{52} = 0,02$

f) $P(\text{between 5 and 8}) = \frac{8}{52} = \frac{2}{13} = 0,15$

g) $P(\text{red between 2 and 8}) = \frac{10}{52} = \frac{5}{26} = 0,19$

h) $P(\text{not a } 10) = 1 - P(10)$

$= 1 - \frac{4}{52} = \frac{12}{13} = 0,92$

Exercise 1 number 4 is on page 395

5) As event A and B are the only possibilities: $P(A) + P(B) = 1$

$P(A) = 2P(B)$

$\therefore 2P(B) + P(B) = 1 \rightarrow P(A) + P(B) = 1$

$\therefore 3P(B) = 1$

$\therefore P(B) = \frac{1}{3} = 0,33$

Exercise 1 number 5 is on page 395

6) $P(\text{lose}) = 1 - 0,08 = 0,92$

Number of losses $= 0,92(75)$

$= 69$ times

Exercise 1 number 6 is on page 395

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7) $P(\text{under } 40) = \frac{1}{6}$

Number of people under 40 $= 360\left(\frac{1}{6}\right)$

$= 60$ people under 40 years of age

Exercise 1 number 7 is on page **395**

8) $P(\text{another blue}) = \frac{1}{9} = 0{,}11$

Exercise 1 number 8 is on page **395**

9)

a) $P(\text{not having a sandwich}) = 1 - 0{,}8 = 0{,}2$

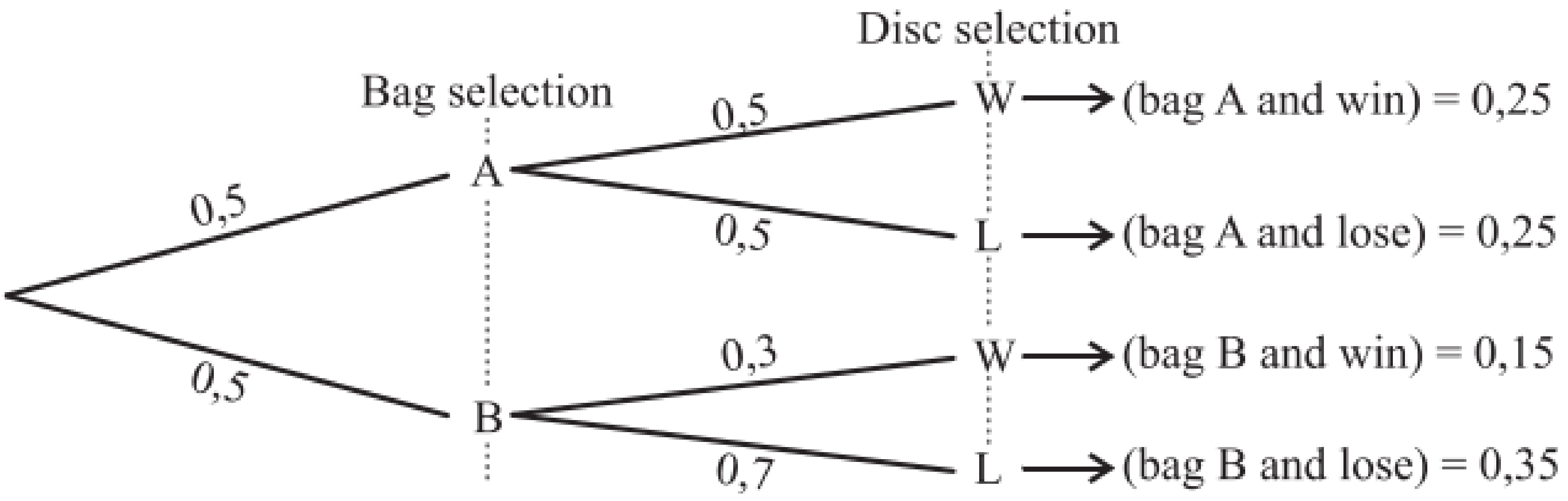
b) Number of sandwiches $= 0{,}8 \times 30 = 24$

Exercise 1 number 8 is on page **395**

Exercise 2 Solutions:

1)

a)



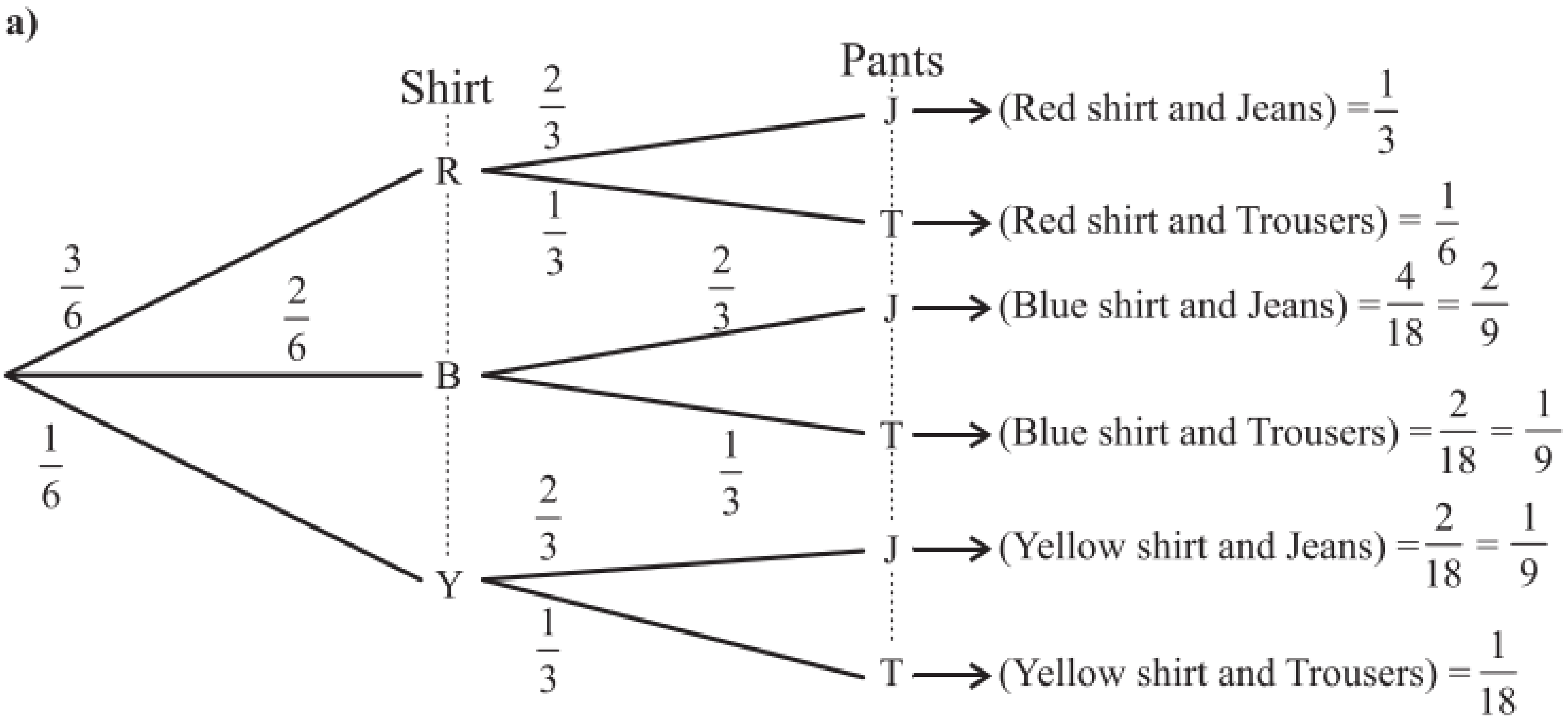
b) $P(\text{win}) = 0{,}25 + 0{,}15$

$= 0{,}4$

Exercise 2 number 1 is on page **395**

2)

a)



b) $P(\text{yellow}) = \frac{1}{9} + \frac{1}{18} = \frac{1}{6} = 0{,}17$

c) $P(\text{B and T}) = \frac{1}{9} = 0{,}11$

d) $P(\text{jeans}) = \frac{1}{3} + \frac{2}{9} + \frac{1}{9} = \frac{6}{9} = 0{,}67$

e) $P(\text{not blue}) = 1 - P(\text{blue})$

$= 1 - \left(\frac{2}{9} + \frac{1}{9}\right) = \frac{6}{9} = 0{,}67$

Exercise 2 number 2 is on page **396**

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3)

		Second Dice					
		1	**2**	**3**	**4**	**5**	**6**
First Dice	**1**	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

a) $P(6)=\frac{5}{36}=0{,}14$

b) $P(\text{greater than } 10)=\frac{3}{36}=\frac{1}{12}=0{,}08$

c) $P(\text{greater than } 12)=\frac{0}{36}=0$

d) $P(\text{less than } 5)=\frac{6}{36}=\frac{1}{6}=0{,}17$

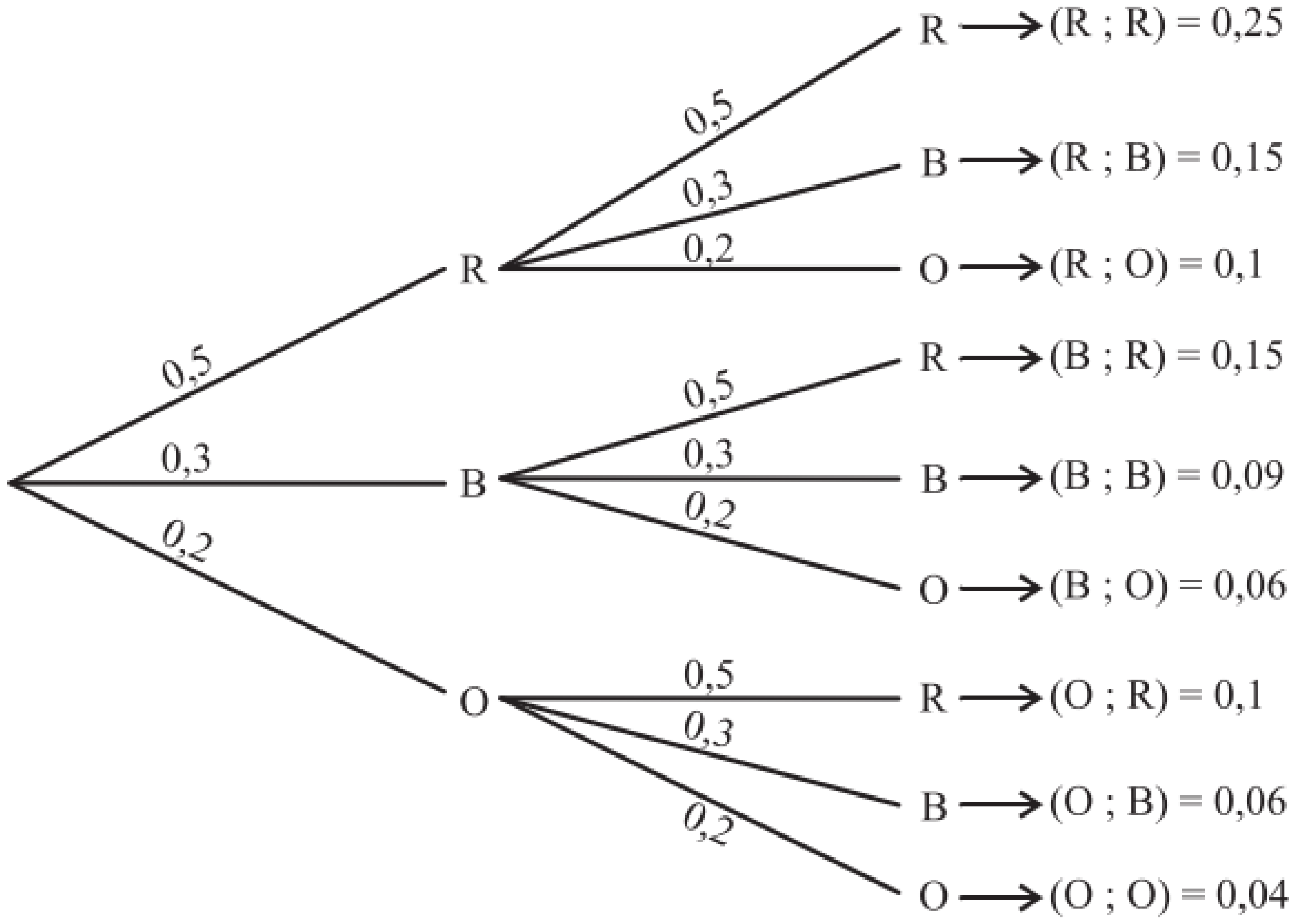
Exercise 2 number 3 is on page **396**

4)

a)

		Second Draw									
		R	R	R	R	R	B	B	B	O	O
First Draw	R	R ; R	R ; R	R ; R	R ; R	R ; R	R ; B	R ; B	R ; B	R ; O	R ; O
	R	R ; R	R ; R	R ; R	R ; R	R ; R	R ; B	R ; B	R ; B	R ; O	R ; O
	R	R ; R	R ; R	R ; R	R ; R	R ; R	R ; B	R ; B	R ; B	R ; O	R ; O
	R	R ; R	R ; R	R ; R	R ; R	R ; R	R ; B	R ; B	R ; B	R ; O	R ; O
	R	R ; R	R ; R	R ; R	R ; R	R ; R	R ; B	R ; B	R ; B	R ; O	R ; O
	B	B ; R	B ; R	B ; R	B ; R	B ; R	B ; B	B ; B	B ; B	B ; O	B ; O
	B	B ; R	B ; R	B ; R	B ; R	B ; R	B ; B	B ; B	B ; B	B ; O	B ; O
	B	B ; R	B ; R	B ; R	B ; R	B ; R	B ; B	B ; B	B ; B	B ; O	B ; O
	O	O ; R	O ; R	O ; R	O ; R	O ; R	O ; B	O ; B	O ; B	O ; O	O ; O
	O	O ; R	O ; R	O ; R	O ; R	O ; R	O ; B	O ; B	O ; B	O ; O	O ; O

b)



c) $P(\text{Red})=0{,}25+0{,}15+0{,}1+0{,}15+0{,}1 \rightarrow$ the two-way table could also be used
$=0{,}75$

d) $P(\text{same colour})=0{,}25+0{,}09+0{,}04 \rightarrow$ the two-way table could also be used
$=0{,}38$

e) $P(\text{B or O})=0{,}15+0{,}09+0{,}06+0{,}1+0{,}06+0{,}04+0{,}15+0{,}1 \rightarrow$ the two-way table could also be used
$=0{,}75$

Exercise 2 number 4 is on page **396**

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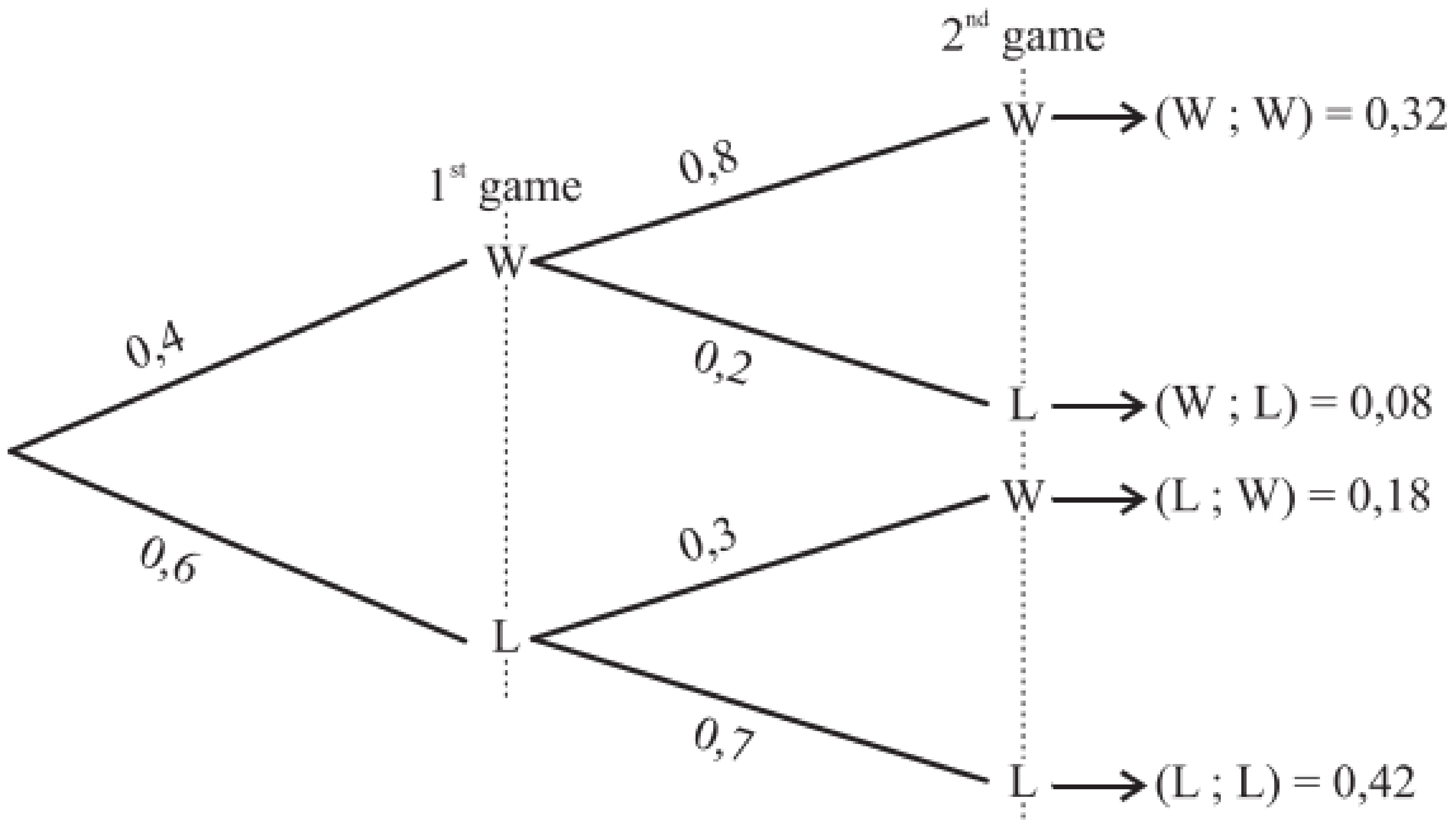
5)

a) 0,6

b)



c) $P(W\ ;\ W) = 0,32$

d) $P(\text{losing 2nd game}) = 0,08 + 0,42 = 0,5$

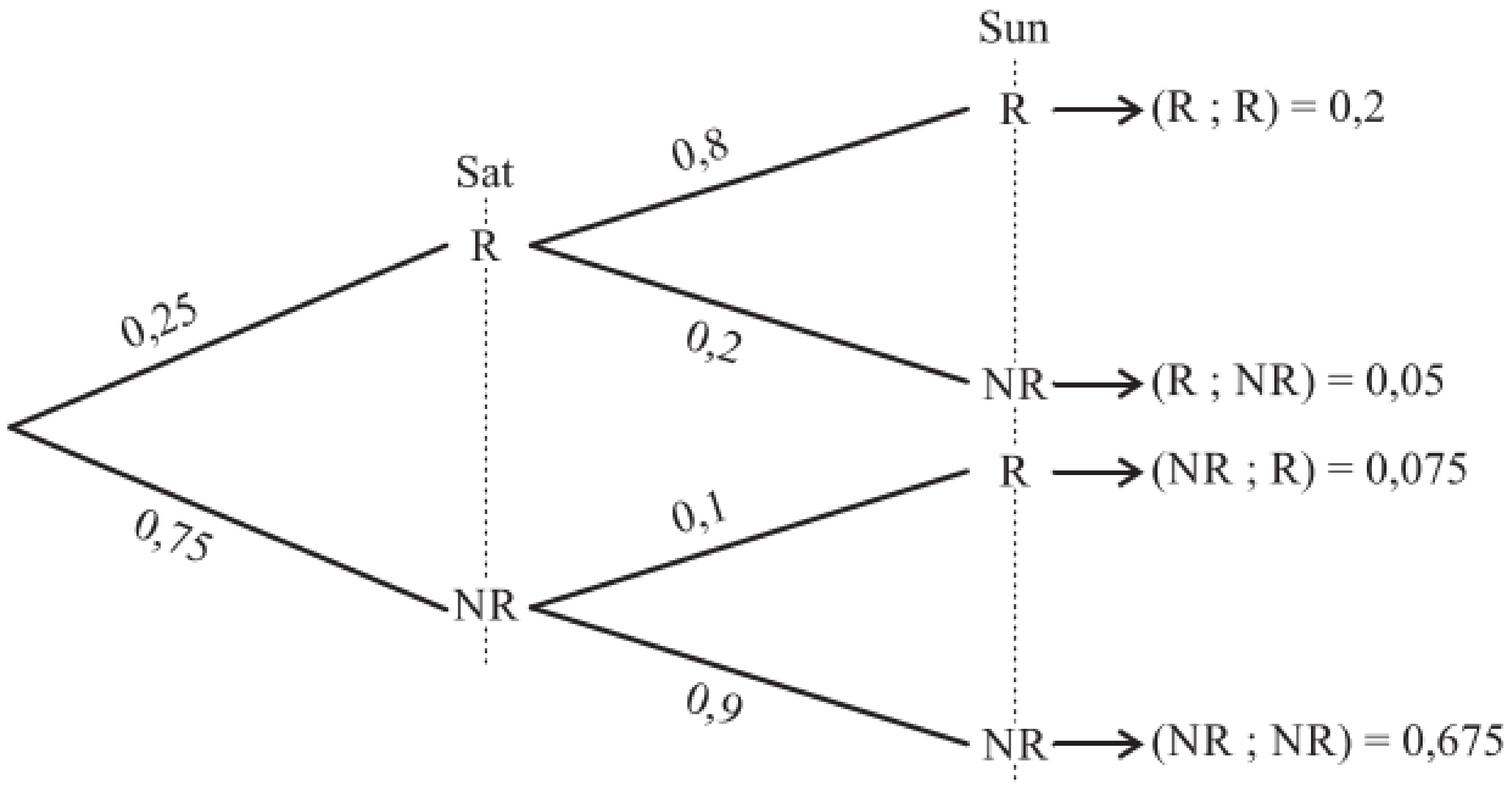
e) $P(\text{winning 2nd game}) = 0,32 + 0,18 = 0,5$

Exercise 2 number 5 is on page **396**

6)

a) $P(\text{not raining on Sat}) = 1 - 0,25 = 0,75$

b)



c) $P(\text{not raining on Sun}) = 0,05 + 0,675 = 0,725$

Exercise 2 number 6 is on page **396**

The Mixed Exercise Solutions:

1)

a) $P(\text{green}) = \frac{13}{20} = 0,65$

b) $\text{number of green} = 0,65(60) = 39 \text{ times}$

The Mixed Exercise number 1 is on page **396**

2)

a) $P(M) = \frac{2}{11} = 0,18$

b) $P(\text{vowel}) = \frac{4}{11} = 0,36$

c) $P(S) = \frac{1}{11} = 0,09$

d) $P(\text{consonant}) = \frac{7}{11} = 0,64$

e) $P(T) = \frac{2}{11} = 0,18$

f) $P(B) = \frac{0}{11} = 0$

g) $P(I) = \frac{1}{11} = 0,09$

h) $P(\text{A or E}) = \frac{3}{11} = 0,27$

The Mixed Exercise number 2 is on page **397**

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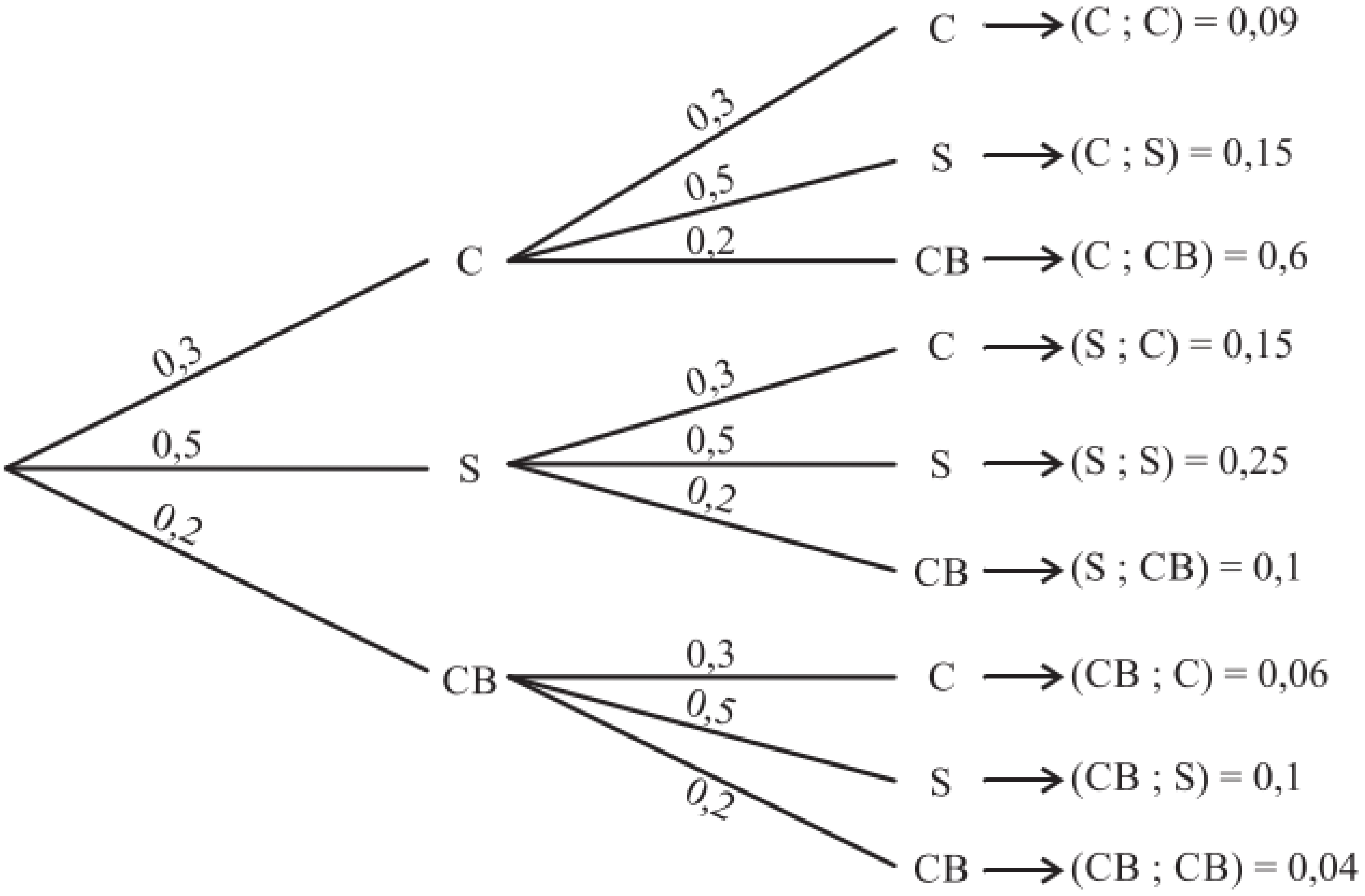
3)

a)



b) $P(\text{C and S}) = 0,15 + 0,15 = 0,3$

c) $P(\text{CC or SS or CBCB}) = 0,09 + 0,25 + 0,04 = 0,38$

The Mixed Exercise number 3 is on page **397**

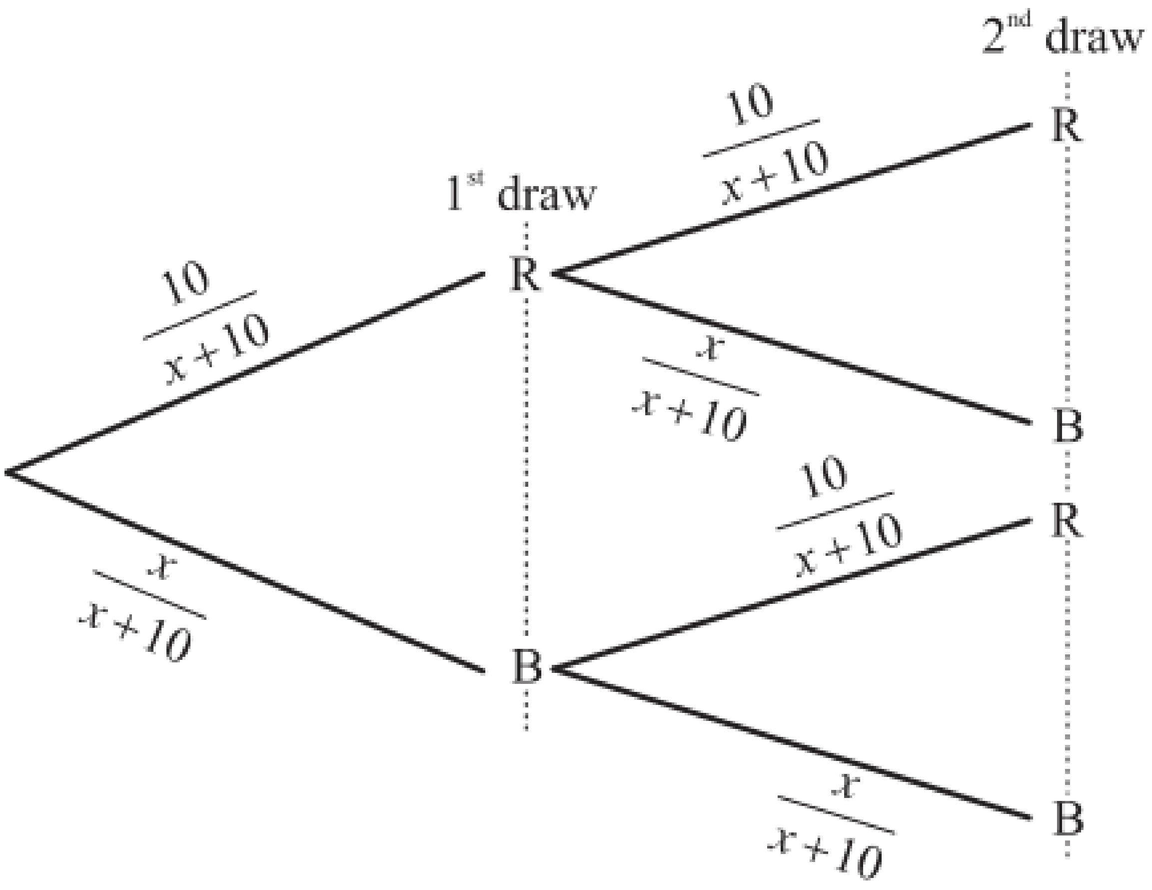
4)

a) $10 + x$

b) $P(\text{red}) = \dfrac{10}{10+x}$

c) $P(\text{blue}) = \dfrac{x}{10+x}$

d)



e) $P(RR) = \left(\dfrac{10}{x+10}\right)^2$

$\therefore \dfrac{4}{9} = \dfrac{100}{(x+10)^2}$

$\therefore 4(x+10)^2 = 900$

$\therefore 4\left(x^2 + 20x + 100\right) = 900$

$\therefore 4x^2 + 80x - 500 = 0$

$\therefore 4\left(x^2 + 20x - 125\right) = 0 \rightarrow$ divide both sides by 4

$\therefore (x-5)(x+25) = 0$

$\therefore x = 5$ blue balls or $x \neq -25 \rightarrow$ N/A you can't have a negative number of balls

The Mixed Exercise number 4 is on page **397**

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5)

a) $H^2 = 100^2 - 60^2$

$\therefore H = 80\,\text{cm}$

$\text{Area} = \frac{1}{2}(120)(80) \rightarrow \frac{1}{2}(\text{base})(\text{height})$

$= 4800\,\text{cm}^2$

b) $P(\text{shaded}) = \frac{\text{shaded Area}}{\text{Area of Triangle}}$

$\therefore 0{,}03 = \frac{\text{shaded area}}{4800}$

$\therefore \text{shaded area} = 0{,}03 \times 4800$

$= 144\,\text{cm}^2$

$\therefore \text{shaded area of each square} = \frac{144}{4} = 36\,\text{cm}^2$

$\therefore \text{length of each square} = 6\,\text{cm} \rightarrow \sqrt{36}$

The Mixed Exercise number 5 is on page **397**

6)

a) Largest Number = 5 + 6 = 11
Smallest Number = 1 + 0 = 1

b)

		Spinner 2			
		0	2	2	6
Spinner 1	**1**	1	3	3	7
	1	1	3	3	7
	3	3	5	5	9
	5	5	7	7	11

c) $P(5 \text{ or larger}) = \frac{9}{16} = 0{,}56$

d) $P(3) = \frac{5}{16} = 0{,}31$

e) $P(\text{same number}) = \frac{0}{16} = 0$

f) $P(\text{spinner 1 landing on 5 and spinner 2 landing on 2}) = \frac{2}{16} = \frac{1}{8} = 0{,}125$

The Mixed Exercise number 6 is on page **397**

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ANNUAL TEACHING PLAN
Summary - Grade 9

	Subject	Time	Chapter
Term 1	Whole numbers	4,5 hours	1
	Integers	4,5 hours	2
	Common Fractions	4,5 hours	3
	Decimal Fractions	4,5 hours	4
	Exponents	5 hours	5
	Numeric and Geometric Patterns	4,5 hours	6
	Functions and Relationships	4 hours	7
	Algebraic Expressions	4,5 hours	8 and 9
	Algebraic Equations	5 hours	10
Term 2	Construction of Geometric Figures	9 hours	11
	Geometry of 2D Shapes	9 hours	12
	Geometry Straight Lines	9 hours	13
	Theorem of Pythagoras	5 hours	14
	Area and Perimeter of 2D Shapes	5 hours	15
Term 3	Functions and relationships	5 hours	7
	Algebraic Expressions	9 hours	8 and 9
	Algebraic equations	9 hours	10
	Graphs	12 hours	16
	Surface area and volume of 3D shapes	5 hours	17
Term 4	Transformation geometry	9 hours	18
	Geometry of 3D objects	9 hours	19
	Collect, Organise and Summarize data	4 hours	20
	Represent Data	3 hours	20
	Interpret, Analyse and Report Data	3,5 hours	20
	Probability	4,5 hours	21

The teaching plan above is recommended by the National Department of Education from the CURRICULUM AND ASSESSMENT POLICY STATEMENTS (CAPS)

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Notes:

Our ref: GM2020/8636LG

Date: 4 January 2021

Dear Sirs

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Yours faithfully
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